THE CHARACIFORM FISHES
OF THE APURE RIVER DRAINAGE, VENEZUELA

By

DONALD C. TAPHORN

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1990

ACKNOWLEDGMENTS

Saying thank you is hardly adequate to repay the many people who have helped me in this project. They have given me tremendous gifts: precious time, sound advice and useful suggestions, as well as moral and financial support and many other things. They helped get the fish out of the water and into a jar in the museum, get the sometimes jumbled ideas in my head into some semblance of order, get my body out of bed and into the lab, and get the words out of the computer and onto this page. But thank them I must and I do so sincerely.

My parents and family are first in this list of special people who have helped. They are always with me in spite of the large distances that have separated us. Next I thank the many friends, professors, colleagues and students who have helped to make this dissertation possible. They are Dr. Carter Gilbert, cochairman of my committee for these many years and tireless in the dreary task of wading through and correcting the rough drafts, Drs. Horst Schwassmann, Frank Nordlie, and Nigel Smith, who patiently served on my committee and suggested many helpful improvements and Dr. Craig Lilyestrom, his wife María and their children Lynda and Wayne who shared a home with me in Venezuela. During my visits to Gainesville, I enjoyed the warm hospitality of Dr. and Mrs. Carter Gilbert, Mr. and Mrs. George Burgess, and Mr. and Mrs. Terry Converse.

Dr. Kirk Winemiller, Mr. Leo Nico and Mr. Stewart Reid worked on postgraduate degrees in our laboratory, shared in the field work, and

generously provided specimens and information on the ecology of Apure drainage fishes from their master's and doctoral work.

I also thank the friends and colleagues who helped pull the other (usually the deep) end of the seine, Craig Lilyestrom, Craig and Carmen Olds, Leo Nico, Stewart Reid, Kirk Winemiller, Oscar Leon M., Naboth Montilla A., Mike Taphorn, Pablo Osman, Larry Page, Carter Gilbert, Richard Franz, Jack Karr, Jamie Thomerson, Guillermo and Ramón Feo, Alex Flecker and many others too numerous to mention here. Special thanks go to Ing. RNR Angelina Licata and Mr. Oscar Leon Mata for the drawings and to Lic. Jairo Pérez and Ing. Aniello Barbarino D. for the maps. Three technicians have worked with me in the Fish Collection, Aldo García, Eric Sutton and Keyla Marchetto; I am greatly indebted to them for their assistance with the unending museum chores of processing and cataloging the specimens, preparing labels and card files, and keeping the computer records up to date. Several of my students in the Environmental Engineering Department have done thesis work on fishes, and many also held student jobs in the Fish Collection and helped with the museum chores. Special thanks go to Pablo Osman, Norberto Saavedra, Enrique Marzola, Aniello Barbarino Duque, Cecelia Gómez, Guillermo Cedeño, Ricardo Smith, Yury Hernández. I also thank Dr. Richard Schargel for his helpful talks about Apure drainage soils and Prof. Heberto Pacheco and the other personnel of the Cartographic Center of UNELLEZ who helped obtain topographical maps.

The Secretario de Investigación de la UNELLEZ, FONAIAP, FUNDACITE, CONICIT all provided financial support for this project.

TABLE OF CONTENTS

page

ACKNOWLEDGMENTS..... ii

ABSTRACT..... v

INTRODUCTION..... 1

MATERIALS AND METHODS..... 14
Collecting..... 14
Curation..... 14
Material Examined..... 14
Format..... 15

RESULTS..... 21
Characiformes..... 23
Anostomidae..... 31
Characidae..... 100
Characidiidae..... 606
Chilodontidae..... 664
Ctenoluciidae..... 670
Curimatidae..... 677
Cynodontidae..... 721
Erythrinidae..... 739
Gasteropelecidae..... 760
Hemiodontidae..... 766
Lebiasinidae..... 777
Parodontidae..... 796
Prochilodontidae..... 808

DISCUSSION..... 823
Ecological Considerations..... 823
Zoogeographical Considerations..... 854

LITERATURE CITED..... 864

APPENDIX..... 887

BIOGRAPHICAL SKETCH..... 891

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

THE CHARACIFORM FISHES
OF THE APURE RIVER DRAINAGE, VENEZUELA

By

DONALD C. TAPHORN

May, 1990

Chairman: Dr. Carter R. Gilbert
Major Department: Zoology

The Apure River drainage of Venezuela collects waters from many different aquatic habitats that vary greatly in geology, climate, vegetation and altitude. Over ten years of sampling has yielded 354 species of freshwater fishes pertaining to ten orders and forty-one families. This report includes taxonomic synonymies, keys, illustrations, morphological descriptions, distribution maps, data on abundance, habitat, life history strategy and diet for 138 Characiform species of the families Anostomidae, Characidae, Characidiidae, Chilodontidae, Ctenoluciidae, Curimatidae, Cynodontidae, Erythrinidae, Gasteropelecidae, Hemiodontidae, Lebiasinidae, Parodontidae, and Prochilodontidae.

Fish distribution within the Apure River drainage is primarily governed by two parameters, altitude and water chemistry. The few characiforms adapted to mountain and piedmont conditions tend to be restricted in distribution to only those areas.

In the llanos, two assemblages are recognized. Whitewater, muddy streams are the most common habitat in the drainage, but few characiforms are restricted only to them. Blackwater habitats with distinct fish assemblages exist in isolated pockets in the Aguaro-Guariquito drainage, in the Caicara Creek drainage of northern Apure state, and in west-central Barinas state.

The drastic changes in climate between wet and dry season in the Apure River drainage have molded characiform life history strategies. Most characiforms have adopted an r1 or r2 life history strategy. Of 68 species that have adopted the r1 strategy, most are small omnivorous fishes with low juvenile and adult survivorship, low fecundity per reproductive bout (but repeated reproduction throughout the rainy season), short generation times (many live less than one year), and widely fluctuating population densities during the year. The other 70 species present have been classified as r2 strategists. These species typically are larger, are often migratory, and reproduce annually in a single massive spawning event. Juvenile survivorship is low, but adults live for several years and reach larger sizes. Populations fluctuate greatly from wet to dry season because of the high juvenile mortality. No characiforms in the Apure drainage have adapted the K-strategy.

The Apure drainage ichthyofauna is a mosaic of relatively young species that have evolved in the whitewater habitats and blackwater species probably derived from an older Guyana Shield fish fauna.

INTRODUCTION

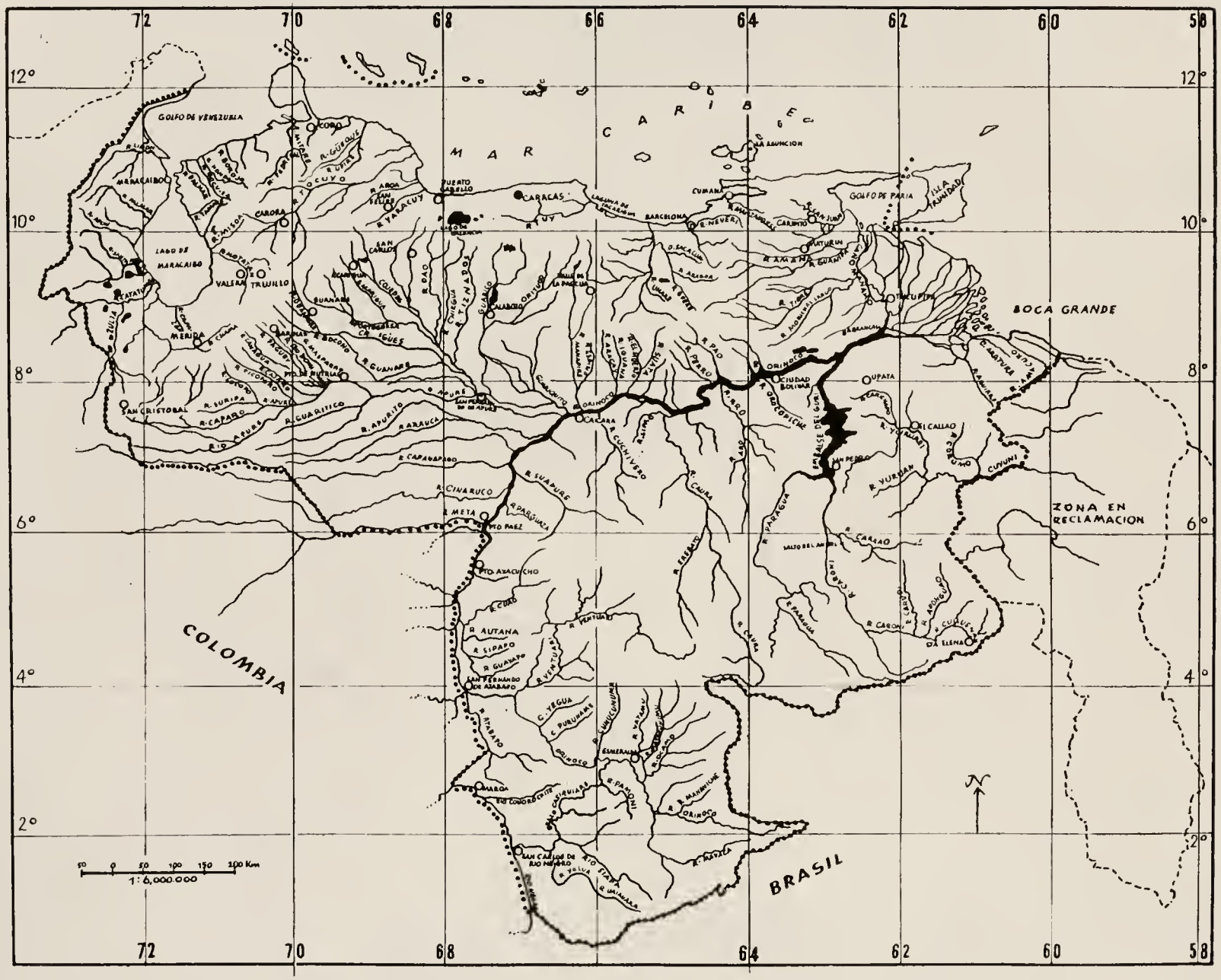
Tropical aquatic ecosystems are suffering rapid modification and deterioration as man's growing population makes ever-increasing demands for water, forest products, and agricultural land. Many Venezuelan rivers are already so polluted that we will never know much, if anything, about their original fish faunas. Fishes are suffering loss of habitat to wetlands drainage programs, habitat modification by dams and dikes, pollution from urban sewage, agricultural fertilizers and biocides sedimentation from deforestation and poor upland watershed management, overfishing, and the introduction of exotic species.

Efforts to produce effective management plans for a rational development of tropical aquatic resources suffer from an almost total lack of basic information about the aquatic organisms that occupy these systems. Not even lists of the fishes, mollusks, crustaceans, aquatic insects, plants, etc., can be found for most tropical rivers, much less data on abundance, life histories, critical habitat requirements or other aspects of their biology. Furthermore, the majority of these organisms have never been sufficiently sampled, nor has their taxonomy been adequately studied. The literature provides few guides to the identification, and for the most part, original species descriptions are hidden in old primary references not usually available to workers in South America. What little information is available is seldom written in Spanish, and so is of little use to management officials. For these and many other reasons, inventories of tropical aquatic organisms

are desperately needed. The decision to undertake a faunal survey of the Apure River drainage, part of which forms the basis of my doctoral dissertation, is in response to this need.

In South America the Orinoco River Basin (fig. 1) collects the waters of a vast area covering approximately 1,123,000 km^2, second only (although the Río La Plata is longer) to the immense Amazon River Basin to the south, which drains some 7,000,000 km^2 (Zinck 1977, Smith 1981). About three-fourths of the area of the Orinoco Basin falls under Venezuelan jurisdiction, whereas the rest is Colombian. The river traverses some 2,148 km in its journey to the sea from its currently recognized source near Cerro Delgado-Chalbaud in the ancient mountains of the Guyana Shield near the border with Brazil. In my opinion, the true source of the Orinoco is the Guaviare River, which originates in the Andes of Colombia and contributes much more water than the Ventuari. In any case, the Orinoco flows west from its Venezuelan source, at first descending through dense tropical forest that grows in the well-weathered rocky drainages of the Guyana highlands. After sharing a portion of its reddish-brown waters with the Amazon via the Casiquiare Channel, it receives its first major tributary, the Ventuari, and then veers north to run along the northwestern edge of the Guyana Shield where it marks the boundary between Colombia and Venezuela. Several major tributaries enter the Orinoco from Colombia in this stretch (fig. 1), among the largest of which are the Guaviare, Vichada, Tomo and Meta. At Puerto Páez, the Orinoco turns slightly to the east, and receives the black waters of the Cinaruco and Capanaparo rivers that drain the grassland savannas of southern Apure state. Rocks of the Guyana Shield still project though sandy bottom sediments at this stage. Gradually, the river bends more eastward. Just before reaching Caicara, the muddy waters of the Apure River dump

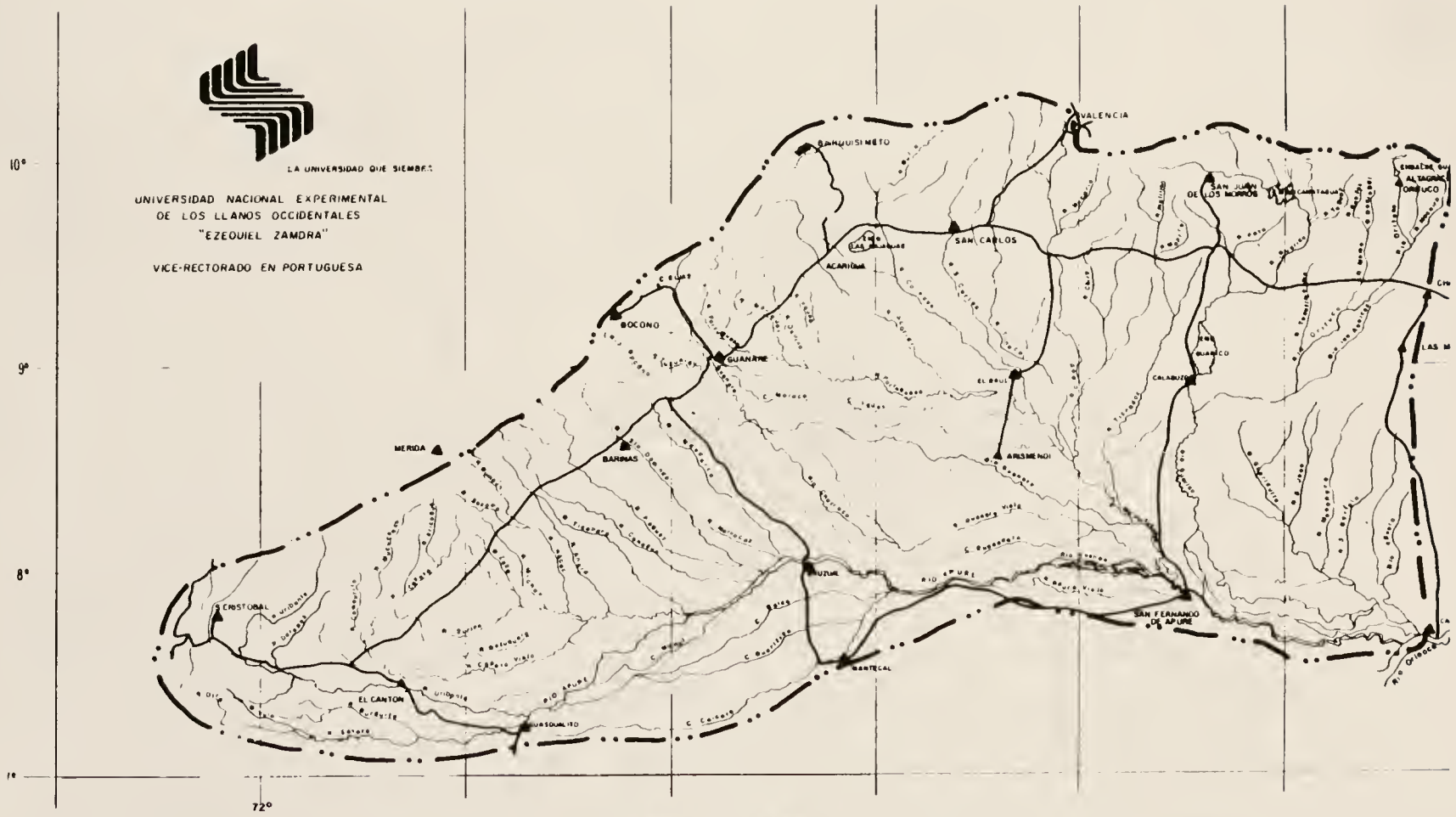
Figure 1. Orinoco River Basin in Venezuela.


MAR CARIBE
GOLFO DE VENEZUELA
LAGO DE MARACAIBO
MARACAIBO
CORO
CARORA
VALERA
TRUJILLO
MERIDA
SAN CRISTOBAL
PUERTO CABELLO
CARACAS
LA GUAIRA
BARCELONA
CUMANA
LA ASUNCION
GOLFO DE PARIA
ISLA TRINIDAD
BOCA GRANDE
ORINOCO
CIUDAD BOLIVAR
UPATA
EL CALLAO
SAN PEDRO
TUCUPITA
ZONA EN RECLAMACION
COLOMBIA
BRASIL
PTO. AYACUCHO
PTO. PAEZ
SAN FERNANDO DE ATABAPO
SAN CARLOS DE RIO NEGRO
DA ELENA
1:6.000.000

their Andean sediments into the main channel of the Orinoco. Since the Orinoco is often full during peak flood of the Apure, it tends to hold back the waters of the Apure, and has formed an interior delta where vast areas flood each year. The Orinoco changes course at this point to run in a northeasterly direction towards the sea. It is bordered by the semi-arid central plains to the north, and the humid Guyana Shield to the south. It picks up vast quantities of black waters from the Caura and Caroní rivers before it enters its highly productive delta and flows into the Atlantic Ocean just south of the island of Trinidad. The average annual outflow is about 33,000 m^3/s (Zinck 1977). The Amazon, by way of comparison, delivers an annual average of about 175,000 m^3/s (Smith 1981).

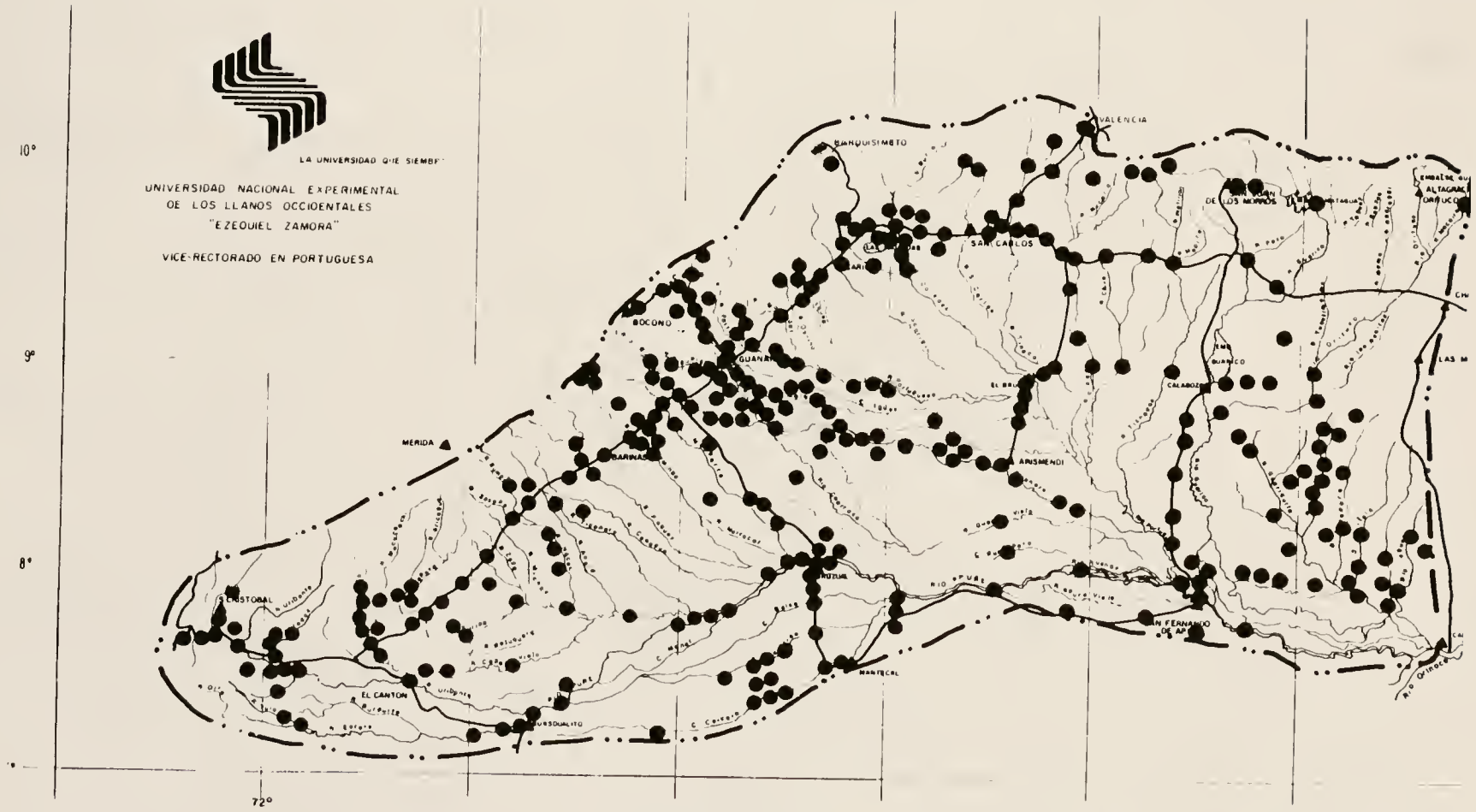
The Apure River drainage lies mostly within 7° and 10° North latitudes, and 66° and 72° West longitudes. It is Venezuela's largest tributary (in terms of drainage area) of the Orinoco (fig. 2a & 2b) and drains 167,000 km^2, or nearly 15% of the total area of the Orinoco Basin. Its average flow of nearly 2000 m^3/s (Zinck 1977) divided by the drainage area gives a figure of about 378 mm/year runoff, which is about 24% of the mean precipitation (Saunders & Lewis 1988a). It is exceeded in Venezuela by only two other tributaries, both blackwater rivers from the nutrient poor soils of the Guyana Shield, where rainfall is much higher. The Caroní River, which drains some 93,000 km^2 delivered over 4,000 m^3/s before the enormous Raúl Leone (Guri) Dam was built. The Caura River, slated for future hydroelectric development, carries 2,700 m^3/s. The Guaviare River which drains 159,500 km^2 and the Meta River with 103,000 km^2 are two of the major Orinoco tributaries in Colombia (Zinck 1977). The headwaters of the Apure drain the southeastern flank of the Andes, and are located approximately 800 km by river from the Orinoco River. Over 15% of the drainage is mountainous

Figure 2a. Apure River Drainage in Venezuela.



CUENCA DEL RIO APURE

Figure 2b. Apure River Drainage in Venezuela showing collecting sites.



CUENCA DEL RIO APURE

(above 500m in elevation). Transit time from the Andes to the Orinoco varies seasonally in the range of one to four weeks (Saunders & Lewis 1988a,b). On the way, the numerous branches of anastomosing rivers cross the llanos, flat alluvial plains that formed in the late Pleistocene over older marine sediments. In the wet season, most of the lower part of the drainage is inundated by sheet flooding. The floodplain of the Apure is much more extensive than that of most rivers. An internal delta of about 5000 km^2 forms where the Apure and the Arauca (the first major tributary of the Orinoco to the south) flow into the Orinoco. When discharge is high in the Orinoco, a large inland sea forms between the mouths of the Capanaparo river (the next Orinoco tributary to the south) and the Apure. The alternation of wet and dry seasons causes annual changes in river level of about six to eight meters. Using river level values from San Fernando de Apure, Saunders & Lewis (1988a) defined four hydrologic phases to describe the relationship between the river and the floodplain. The river is not in contact with the floodplain during the first, low-water phase, which corresponds to stage heights below 38 m. The rains, which usually start in April or May, initiate the second, rising-water phase, during which the river is still within its banks (38-42m). The inundation phase commences when stage heights surpass 42m, and river water floods onto the surrounding floodplain. Flooding usually begins in July, and peaks in September or October. When the dry season sets in and water levels drop to below 42m, the fourth, or falling-water phase begins (42-38m).

Of all of the Orinoco tributaries, the Apure is by far the most accessible, with good, all-season roads crossing all of its major drainage systems. This factor alone was enough to select it as my study site, but in addition to easy access the climate and topography are extremely

diverse. As a result, many different aquatic biotopes are included in the drainage. There are cold mountain streams that tear through the Andes at breakneck speeds; tepid, blackwater lowland swamps; large "white-water" muddy rivers that meander slowly through the lower llanos (a Venezuelan term for plains or savanna); and all the varied intergradations of these that can be imagined. The good roads in this region owe their existence to the fertile soils and resultant extensive agriculture that has developed. Deforestation has proceeded virtually unchecked since colonial times. As more and more forests give way to pastures and crops, the aquatic fauna becomes increasingly degraded. Massive fish kills occur almost as a matter of routine when the first rains fall after the months of drought and wash the accumulated pesticides and fertilizers into the drainage in one large dose. Natural aquatic habitats are disappearing rapidly and fish populations are suffering accordingly. This too gave the Apure drainage a high priority as a study area, inasmuch as the fishes sensitive to these changes may not be around indefinitely.

Another factor in the selection of the Apure drainage is that the Apure River and its larger tributaries support a large commercial fishery, and provide a significant source of protein and extra income for rural families. Almost no basic biological data is available for most species. Declining catches in recent years and local conflicts over the best use of aquatic resources in the region has local and federal governments concerned. Most commercial species are migratory, moving in tune with the drastic seasonal changes in water level and flow because of the accentuated wet and dry seasons typical of the western llanos. Funding for impact studies of local dams on commercial species helped pay for the sampling.

The Andean piedmont was characterized as an area of recent speciation by Mago L. (1978), but Andean piedmont rivers, flowing out through narrow valleys into the plains, offer excellent opportunities for hydroelectric power generation. The Venezuelan government, eager to diversify its energy resources now that the end of their vast petroleum wealth is in sight, has projects for dams on almost every major piedmont river system. These dams have denied the commercial species, particularly the coporo, Prochilodus mariae, access to the upland piedmont and montane lotic systems, and disrupt the annual cycle of flood and drought used by migratory species as the cue to make their moves. Commercial species populations are on the decline throughout the Apure drainage, but direct causes are not easily identified because of the wide array of concurrent negative impacts that are occurring. As the commercial fish catch drops, concern is mounting, and governmental interest in finding a solution is growing. But again, lack of basic information about fish populations and ecology hinders progress.

In his seminal work, "Lista de los Peces de Venezuela incluyendo un Estudio Preliminar sobre la Ictiogeografía del País," Mago Léccia (1970) lamented the deplorable state of knowledge of the Venezuelan freshwater fish fauna. He noted that most of the pioneering ichthyological works of Eigenmann, Steindachner, Regan, Kner, Pellegrin, Norman, Fowler and others were based on specimens from just about everywhere in South America except Venezuela. Only the Maracaibo Basin, studied in detail by Leonard P. Schultz (1944a & b, 1949), was relatively well known. Since then, the pace of ichthyological research in Venezuela has quickened considerably. This is principally due to the work of Dr. Mago L. and his students, but contributions have also been made by Agustín Fernández Yépez, Felipe Martín and Manuel Ramírez. However, the present state of knowledge on the freshwater

fishes of Venezuela is far from complete, and most areas still need to be better sampled.

Neotropical characiform fishes have received considerable attention from ichthyologists. C. H. Eigenmann provided the basis for most modern studies with a series of papers published in the late 1800's and early 1900's that culminated in several huge tomes such as his American Characidae series. Other workers such as E. Ahl, J. Böhlke, H. Fowler, J. Géry, J. Hoedeman, R. von Ihering, W. Ladiges, K. Lüling, S. Meek, H. Meinken, N. Menézes, G. Myers, A. and R. Ribeiro de Miranda, T. Roberts, H. Travassos, S. Weitzman and R. Vari have continued the effort to give us a much better idea of the tremendous diversity of form and function represented in this group.

MATERIALS AND METHODS

Collecting

Many different collecting methods were employed, but most collections were made with small, fine-meshed seines. Gill nets (both multifiber nylon, and monofilament), beach seines, cast nets (both fine and commercial mesh sizes), hand nets, and small otter trawls (in the Apure River's main channel) were also used. We also fished with electrofishing gear, rotenone, and hook and line. Some specimens were obtained from commercial fishermen. Fishing effort was not vigorously controlled at each site. Usually sampling continued until no new species appeared. From 1977 to 1989 we made a total of 875 collections in the Apure drainage (fig. 2b).

Curation

Specimens were preserved in 10-15% formalin solution, and later transferred to either 50% isopropanol, or 70% ethanol. Larger specimens were usually slit on the right side to ensure complete preservation.

Material Examined

Most of the specimens examined as part of this study have been deposited in the Museo de Ciencias Naturales de la UNELLEZ--Guanare (MCNG). Additional material is deposited in the Field Museum of Natural History in Chicago (FMNH), the museum of the Illinois Natural History Survey (INHS), the Museo de Biología de la Universidad Central de Venezuela in Caracas (MBUCV), the museum of Sacramento State College, in Sacramento California (SSC), the Texas Memorial Museum in Austin (TMM), the Florida Museum of

Natural History in Gainesville (UF), and the United States National Museum (USNM) in Washington. Other museum acronyms used in this study are: AMNH--American Museum of Natural History; ANSP--Academy of Natural Sciences, Philadelphia; BMNH--British Museum of Natural History; CAS--California Academy of Sciences; CM--Carnegie Museum (now mostly in FMNH and CAS); IU--Indiana University (these specimens are now located mostly in FMNH or CAS); MCZ--the Museum of Comparative Zoology at Harvard; MNHN--Muséum National d'Histoire Naturelle, Paris; MZUSP--the Museum of Zoology of the São Paulo University in Brazil; NMW--the Vienna Natural History Museum; SU--Stanford University (now at CAS, and designated CAS-SU); ZMA--Zoologisch Museum of Amsterdam; ZMB--Zoologisch Museum of Berlin.

Format

The following format has been used to organize the information presented here. A brief introduction summarizing pertinent data for each family is followed by a key to the species known to be present in the Apure drainage. These sections are followed by the species accounts, which are arranged, in sequence, under the following headings:

1. Genus--species--author--year (centered at top).
2. Common Name in Spanish & Common Name in English (if known).
3. Fig. #. This is the figure number(s) of the illustration(s).
4. Map: fig. #. This is the figure number of the dot map showing the Apure drainage distribution.
5. Couplet. #. The couplet(s) where the species keys out is given.
6. Generic synonymy. This section, given as part of the species account for the first species of each genus, includes the principal elements of a generic synonymy: original name, describer, date, and type species. Only primary junior synonyms are listed.

7. Specific Synonymy. The specific synonymy includes the original name, describer, date, and page number, as well as the type locality (only given for citations of original descriptions), junior synonyms, and selected references to Venezuelan specimens or other important reports. It is not intended as a complete synonymy, but in many cases it may be. In most cases synonymies have been copied from the literature. When the original description has been seen by me (many are in unavailable literature) this is so indicated (as: seen).

8. Types. If readily available, museum location of the type material is presented.

9. Comments. Comments are given on the taxonomic status of the species. A synopsis of recent opinions on the status of the species or an explanation of the validity of the name used is often presented.

10. Etymology. The semantic roots or origin of the scientific name are explained.

11. Description Usually just a subheading is given here.

12. Illustrations. All original illustrations in this report are listed first, followed by references to selected illustrations of the species available in the literature. The illustrations are not intended to portray detailed anatomy (for example fin-ray counts) of the species, but rather give an overall impression of the species' basic morphology.

13. Diagnosis. A brief diagnosis of each species is given.

14. Size. The maximum size, as well as the size range of specimens usually encountered are given.

15. Morphology. This section provides a brief physical description of the most notable anatomical features of each species that are not mentioned in the diagnosis.

16. Counts. Fin ray and scale counts are usually given. In most cases only the range is given, but sometimes detailed counts are presented as the count followed by the number of fish counted; for example: AR: 22(9) means a count of 22 anal-fin rays was obtained for nine specimens examined.

The following abbreviations are used: DR--Dorsal Rays; AR--Anal Rays; PR--Pectoral Rays; VR--Ventral or Pelvic Rays; LS--Lateral Scales; LLS--Lateral-Line Scales; PDS--Predorsal Scales; TS--Transverse Scales, (this is sometimes divided into scales above and below the lateral line; CPS--circumpeduncular scale count; GR--gill rakers (if not indicated as the total count of both upper and lower limbs, the figure given is the count of the rakers found on the lower limb of the outer gill arch).

17. Measurements. Common body measurements are presented. The following abbreviations are used: SL--Standard Length; TL--Total Length; GBD--Greatest Body Depth; PDL--Predorsal Length; HL--Head Length; EYE--Eye Diameter; SNT--Snout Length; IO--Interorbital Distance.

18. Pigmentation. Life colors are usually given along with pigmentation patterns that remain in preserved specimens.

19. Distribution and Natural History Comments that don't fit into other sections are given here.

20. Range. The overall geographic range is given.

21. Apure Distribution. Map: fig. #. The number of the distribution map for each species is given. In these maps, the collection localities are plotted on a base map of the Apure drainage. Map scale sometimes required that more than one locality be represented by a single dot. Brief comments on the distribution within the Apure drainage are usually given. One should bear in mind that dot maps of species distribution do not take into account the fact that a few species in the Apure drainage are migratory, and thus

may be present in some areas during only part of the year. Also, non-migratory species will spread out onto the floodplain in the wet season.

22. Habitat. A brief summary of the types of water bodies occupied by the species is given.

23. Abundance. This is a somewhat subjective classification scheme, since collection effort was not standardized to allow actual abundance data to be calculated. I plotted the number of characid species versus the number of collections, then arbitrarily drew separations between four categories as follows:

RARE:	If found in 1 to 5 collections.
UNCOMMON:	If found in 6-25 collections.
COMMON:	If found in 25-200 collections.
ABUNDANT:	If found in more than 200 collections.

As indicated, these data are not quantitative, since fishing effort varied considerably from site to site and not all specimens of each species were preserved (especially true of the larger, more common species). Also, the number of collections may include repeats from the same site. However, the results are useful as a first approximation, and when used in conjunction with the distribution maps they usually reflect a fairly accurate picture of relative abundance, or at least ease of capture.

24. Number of specimens examined. This is the total number of specimens collected in the Apure drainage as part of this investigation. It does not include specimens examined from other collections.

25. Food. Species are usually classified as CARNIVORE, HERBIVORE, OMNIVORE or DETRITIVORE, and the major items that comprise each species diet are listed if known. This section is based on my own field observations of live fishes and from stomach content analyses reported in

the literature, or done by myself, Dr. Craig Lilyestrom, Dr. Kirk Winemiller or Mr. Leo Nico in our lab at UNELLEZ in Guanare.

26. Reproduction. Most of these data are from the literature, or from data gathered by Dr. K. Winemiller for his doctoral research and that was briefly summarized by Winemiller & Taphorn (1989). I use the terminology introduced in that paper to classify the reproductive strategy of each species:

"K-strategy" is characterized by high juvenile and adult survivorship, low fecundity, a long life and generation time (the time from birth or hatching to reproductive maturity), iteroparity (spawning several times per season) and a relatively stable population density throughout the year.

"r1-strategy" is characterized by low juvenile and adult survivorship, low fecundity per individual but repeated spawning bouts (iteroparity), a short life and generation time, and variable population densities throughout the year.

"r2-strategy" is characterized by low juvenile but high adult survivorship, a high fecundity, a long life, semelparity (spawning all at once, once per season) and by great fluctuations in the population density.

27. Migrations. There are no comprehensive studies of migration of the fishes in the Apure Drainage, but we are currently investigating the migration and life cycle of the coporo, *Prochilodus mariae* (Barbarino D. & Taphorn 1989). Local fishermen also provided information.

28. Importance. The commercial, sport, and ornamental uses as well as the harmful or dangerous aspects of each species are discussed in this section.

If no information is available on a given topic, that section is omitted from the species account.

An abbreviated list of the material examined (the number of lots or jars and the total number of specimens) is given for each species in the Appendix. A more detailed list of specimens examined and localities is available from the author. All specimens are deposited in the Collection of Fishes, Zoological Musuem, Museo de Ciencias Naturales de Guanare, at UNELLEZ, in Guanare, Venezuela.

Each family is presented in a separate section, and appears in alphabetical order. A brief diagnosis of the family, with comments on the number of species and their general ecology is followed by a key to the species of the Apure drainage and the individual species accounts. In some keys additional information useful for identification, follows the species name in brackets.

RESULTS

After many years of sampling (1977-1989), during which some 875 collections were made in the Apure drainage, over 14,000 lots of specimens have been processed, cataloged and identified. I have identified 354 species of fishes, belonging to 41 families (Table 1). The so-called ostariophysans strongly dominate the fauna, and comprise 305 (86%) of the 354 species. The ostariophysans have the anteriormost four or five vertebrae fused and include, among South American groups, the orders Characiformes, Gymnotiformes and Siluriformes. The vast number of fishes collected and data generated by the project have made it necessary to limit this dissertation to a subset of the total fish fauna. The order Characiformes was selected because of its great diversity, and a somewhat larger volume of literature that is available for identification of the species. This order includes 13 (32%) of the 41 families and 138 (39%) of the species (Table 1). Only the order Siluriformes, with about 137 species, matches the characiform fishes in diversity in the Apure drainage. The taxonomy of South American fishes is still relatively poorly known, and has been likened to the situation in North America 100 years ago. As more collecting is done, and taxonomic revision continues, the total number of species per family will continue to change, but the relative numbers of species per family will probably not vary as greatly, except perhaps in the order Gymnotiformes, which will probably outstrip the others in terms of new species described.

Table 1. Composition of the Apure River Drainage Fishes.

Order	Family	Species per Family	Species per Order	% of Total
1 RAJIFORMES	1 Potamotrygonidae	4	4	1.1
2 CLUPEIFORMES	2 Clupeidae	2	5	1.4
	3 Engraulidae	3		
3 SALMONIFORMES*	4 Salmonidae	1	1	0.2
4 CHARACIFORMES	5 Anostomidae	12	138	38.9
	6 Characidae	89		
	7 Characidiidae	11		
	8 Chilodontidae	1		
	9 Ctenoluciidae	1		
	10 Curimatidae	8		
	11 Cynodontidae	3		
	12 Erythrinidae	3		
	13 Gasteropelecidae	1		
	14 Hemiodontidae	2		
	15 Lebiasinidae	3		
	16 Parodontidae	2		
	17 Prochilodontidae	2		
5 SILURIFORMES	18 Ageneiosidae	3	137	38.9
	19 Aspredinidae	7		
	20 Astroblepidae	1		
	21 Auchenipteridae	10		
	22 Callichthyidae	7		
	23 Cetopsidae	3		
	24 Doradidae	16		
	25 Hypophthalmidae	1		
	26 Loricariidae	41		
	27 Pimelodidae	39		
	28 Trichomycteridae	9		
6 GYMNOTIFORMES	29 Apteronotidae	16	31	8.7
	30 Electrophoridae	1		
	31 Gymnotidae	1		
	32 Hypopomidae	3		
	33 Rhamphichthyidae	3		
	34 Sternopygidae	7		
7 ATHERINIFORMES	35 Belonidae	2	10	3.0
	36 Rivulidae	6		
	37 Poeciliidae	2		
8 SYNBRANCHIFORMES	38 Synbranchidae	1	1	0.2
9 PERCIFORMES	39 Cichlidae	23	25	7.0
	40 Sciaenidae	2		
10 PLEURONECTIFORMES	41 Soleidae	2	2	0.6

Characiformes

Characiform fishes are ostariophysans, the group of fishes that dominates freshwater habitats in most of the world. Ostariophysans are combined into a group because they all have the first few vertebra modified and linked to the surface of their bodies by a series of modified bones to form what is presumed to be a listening device, or vibration detector. Characiforms have gone farther with this device than most of their cousins the catfishes, knifefishes, carps and suckers (the other ostariophysans). They have developed a complete Weberian apparatus in which the tripus is connected to the body of the third vertebra by means of a vibrating lamina. This mechanism presumably transmits sounds or vibrations picked up on the gas bladder to the inner ear (Géry 1977). Better hearing could perhaps account in part for the dominance of the ostariophysans in most freshwater ecosystems of the world (Fink & Fink 1981). Weitzman (1954, 1962) provided an extensive osteological definition of characiform fishes and Fink & Fink (1981) discussed their relationships with the other ostariophysans. The group is so diverse morphologically that they tend to defy succinct definition. About all one can say is that they all have scales and teeth on the jaws or lips! Actually, not even that is true of all characiforms since a few species from the high Andes in southern South America have lost their scales completely and the Curimatidae are toothless (at least as adults; juveniles have teeth in the early developmental stages). Many are small schooling species that have a chemoreceptory sensory system that, upon detection of substances released by school members under attack or stress, will trigger a "fright response," causing the school to adapt defensive maneuvers.

No consensus has yet been reached by workers on characiform upper-level taxonomy. For many years almost all characoids were lumped in the family Characidae (Eigenmann 1917, Weitzman 1962). The group was subdivided by Greenwood et al. (1966), which (for Characiformes) is based largely on the findings of Dr. Stanley Weitzman. Since then, the group, and the dividing lines between the families and subfamilies, have been topics of constant investigation, and debate. Géry (1977) proposed several modifications. In Table 2 the two schemes are contrasted for South American groups.

Table 2. Comparison of family level taxonomy of Characiformes.

Greenwood et al. (12 families)	Géry (11 families)	Used Here (13 families)
Characidae	Characidae	Characidae
Characidae	Characidiidae	Characidiidae
Characidae	Serrasalmidae	Characidae
Characidae	Crenuchidae	Characidae
Erythrinidae	Erythrinidae	Erythrinidae
Ctenoluciidae	Ctenoluciidae	Ctenoluciidae
Cynodontidae	Characidae	Cynodontidae
Lebiasinidae	Lebiasinidae	Lebiasinidae
Parodontidae	Hemiodidae	Parodontidae
Gasteropelecidae	Gasteropelecidae	Gasteropelecidae
Prochilodontidae	Curimatidae	Prochilodontidae
Curimatidae	Curimatidae	Curimatidae
Anostomidae	Anostomidae	Anostomidae
Hemiodontidae	Hemiodidae	Hemiodontidae
Chilodontidae	Curimatidae	Chilodontidae

Thus, the scheme of Greenwood et al. (1966) would leave South America with 12 families of Characiformes to Géry's 11. In more recent works, some of these families have been promoted to familial or demoted to subfamilial rank. Weitzman & Géry (1981) defined the Characidiinae. Nelson (1984) listed Cynodontinae (which he earlier [1976] recognized as a family), as a subfamily of Characidae; Vari (1989) treated it as a tribe of the Characidae. Other groups have had the familial limitations better clarified and justified, as for example Vari's (1983, 1989) treatment of Curimatidae, Prochilodontidae, Anostomidae and Chilodontidae. Nelson (1984) included only eight families: Hemiodontidae, Curimatidae, Anostomidae, Erythrinidae, Lebiasinidae, Gasteropelecidae, Ctenoluciidae and Characidae, thus demoting again the Prochilodontidae, Cynodontidae, Parodontidae and Chilodontidae. Changes will continue. Except for the recognition of the family Characidiidae, I have followed the classification of Greenwood et al., for a total of 13 families. The correct spellings of Hemiodontidae and Chilodontidae (vs Hemiodidae and Chilodidae) are also as yet unresolved. The type genera are Hemiodus and Chilodus.

I have adopted this system as a matter of practical convenience. This should not be interpreted as support for any particular position in the controversy of higher level relationships of characiforms. For convenience, and since taxonomic affinities are as yet unresolved at various levels, the families, genera and species are discussed in alphabetic rather than taxonomic order.

The characiform fishes exhibit an incredible diversity of form and occupy a wide array of ecological niches. Eigenmann (1917), Weitzman (1962) and Fink & Fink (1981) all marveled at the incredible explosive radiation of this group in South America, which surpasses that of

the marsupials in Australia. Although many families contain widely diverging morphotypes, I will try to briefly characterize each.

The Characidae comprises the most morphologically diverse group and also includes the largest number of species. Although most species are small minnow-like tetras ("sardinas" in Venezuela), this family includes the piranhas, giant pacus, pike characins, strange tusked scale-eaters, tiny killyfish-like inhabitants of blackwater streams, neon tetras, silver dollars and palometas, and South American characid versions of trout, salmon, clupeids and anchovies. The Erythrinidae is a small family of large to medium fishes that are cylindrical, bowfin-like predators, typical of shallow lentic habitats. The Ctenoluciidae is represented by only a few species of elongate gar-like surface predators. Cynodontids are large, riverine predators with keeled, compressed bodies, large eyes and expanded pectoral fins adapted to life near the surface in strong currents. Their extremely large canines give these piscivores a particularly fierce appearance. Lebiasinids include two divergent groups: the "Creole carps," Lebiasina, are medium-sized predators that inhabit mountain streams, whereas Pyrrhulina and relatives are small, colorful fishes typical of vegetation-choked lowland ponds. The Characidiidae and Parodontidae include ecological equivalents of North American darters, adapted to life in the riffles or mountain streams. The hatchetfishes of the family Gasteropelecidae are bizarre, insectivorous, surface-dwelling fishes with incredibly expanded coracoid bones (Weitzman 1954, 1960), and very large pectoral-fins that, when rapidly vibrated, give these fish the ability to "fly." Prochilodontids and curimatids are medium to large sized fishes reminiscent of carps and suckers. They feed on mud, algae and detritus, and comprise a large percentage of the biomass in most

tropical waters. They frequently support productive local commercial fisheries. Many species make spectacular annual migrations to feeding or breeding grounds. Anostomids and hemiodontids include mostly herbivores and planktivores, with fusiform bodies and conical heads adapted to swimming in fast currents. The chilodontids are small to medium-sized headstanders similar to the curimatids, but with teeth.

The differing, still varying taxonomic classifications of characiforms exist primarily because current taxonomic groups for the most part reflect different authors' attempts to group morphologically similar taxa together. Differing opinions as to exactly which characters are "similar" and which are not leads to different conclusions. Although Eigenmann (1917) expressed much concern about the monophyly of the numerous upper level taxa he described, the methodologies available at that time were inadequate. He remarked that the tremendous "radial adaptation" of characiform fishes was at once a paradise for evolutionary biologist and a nightmare for taxonomists seeking a useful system of names. Durbin Ellis (1918) came to the conclusion that the genera Hyphessobrycon and Hemigrammus were conveniences, and not natural entities (ie. monophyletic units). Recent efforts, such as those as Vari (1989), to base taxonomy on shared derived characters and that reflect the phylogenetic history of the fishes would seem to be the only approach that might eventually lead to agreement among taxonomists instead of continuing controversy. The characiform families, and especially the Characidae, contain such divergent groups of fishes that it is difficult to write a key that is both easy to use and reasonably precise. The following key should work for most individuals of most species currently known from the Apure drainage. Readers are also referred to Taphorn & Lilyestrom (1984) for keys to all the freshwater families in Venezuela.

Key to the Characiform families present in the Apure River drainage.

1a. Lips and jaws completely lacking teeth of any kind...
CURIMATIDAE

1b. Teeth present on jaws or lips (teeth on lips may be small and difficult to see without magnification)... ...2

2a. (1b) Teeth present only on lips, none on jaws ...3

2b. Lips without teeth; upper or both jaws with teeth... ...4

3a. (2a) Gills normal; mouth large and evertible to form a round, sucking disk; teeth present on edges of lips, teeth small, comb-like and numerous (many more than 20 on either side), arranged in single row at sides of lips, and in two rows near center (midline) of lips; predorsal spine present, embedded in flesh just anterior to dorsal fin; large species that exceed 200 mm SL in the first year of growth... PROCHILODONTIDAE

3b. Gills with fourth arch dilated (expanded), its surface with folds and wrinkles that mesh with fifth arch; mouth small, not completely evertible; teeth larger, not very numerous (less than 20 per jaw), in single row; no predorsal process present; small species that seldom exceed 200 mm SL CHILODONTIDAE

4a. (2b) Lower jaw without teeth, or without teeth at center (near symphysis)... ...5

4b. Lower jaw with complete series of teeth... ...6

5a. (4a) Teeth of upper jaw arranged in semicircle; pectoral fins not greatly expanded, usually not as long as head; cranium without fontanels; lower jaw never with teeth at sides, usually completely lacking teeth... HEMIODONTIDAE

5b. Teeth of upper jaw arranged in straight line; pectoral fins greatly expanded, usually longer than head; cranium with large fontanels; lower jaw usually with a few teeth at sides...

PARODONTIDAE

6a. (4b) Lower jaw trapdoor-like, with extremely large canine teeth, (the length almost equal to or surpassing eye diameter) that fit into special "sockets" present in upper jaw and cranium when mouth is shut... CYNODONTIDAE

6b. Lower jaw without extremely large canines, sometimes with small canines that measure less than one third of eye diameter, but usually with multicuspid teeth... ...7

7a. (6b) Adipose fin present... ...8

7b. Adipose fin absent... ...13

8a. (7a) Scales ctenoid; jaws extremely elongate and anal fin with fewer than fifteen rays... CTENOLUCIIDAE

8b. Scales cycloid; jaws usually not extremely elongate, but if so, anal fin with more than 15 rays... ...9

9a. (8b) Branquial membranes fused to isthmus for nearly their entire length; mouth with 6-8 large rabbit-like, sometimes unusually shaped incisors... ANOSTOMIDAE

9b. Branquial membranes free from isthmus; teeth variable, but not usually as above... ...10

10a. (9b) Chest bones (coracoids) greatly expanded to form a deep narrow keel; dorsal-fin origin behind that of anal fin; lateral line short, usually directed down towards anal fin origin; pectoral fins greatly enlarged for flight...

GASTEROPELECIDAE

10b. Chest usually not greatly expanded, but if so, then dorsal-fin origin is at a level with, or in front of that of anal fin; lateral line, if present not usually directed down towards anal-fin origin; pectoral fins variable... ...11

11a (10b) Lower jaw with two rows of tricuspid teeth (the second row of small teeth sometimes difficult to see); upper jaw with only one row of tricuspid teeth and without conical or canine teeth...

LEBIASINIDAE (Lebiasina)

11b. Teeth not as described above... ...12

12a. Pectoral and pelvic fins enlarged, inserted very low on body and directed under chest (to support fish resting on substrate); pectoral fin with the first three or four rays thickened and unbranched; premaxillary teeth always in a single row; chest and abdomen flattened (adapted to benthic life as in North American darters); head conical; mouth small usually subterminal to ventral (but terminal in a few species)...CHARACIDIIDAE (in part)

12b. (11b) Pectoral and pelvic fins not particularly expanded, usually inserted near or just below midbody, (pectorals not used to support body when resting on substrate); first three or four rays not thickened, usually only first one or two unbranched; premaxillary teeth in one to three rows, but usually two; chest and abdomen rounded; head not usually conical; mouth variable...

CHARACIDAE (in part)

13a. (7b) Large (up to 1000 mm SL) predators with wide terminal mouths armed with canine teeth on premaxilla and dentary, and sometimes on maxilla; scales relatively large (some nearly size of eye)...

ERYTHRINIDAE

13b. Small (less than 40 mm SL) fishes with small, superior or terminal mouths that lack large canine teeth (teeth usually small to moderate in size, conical or multicuspid); scales relatively small... ...14

14a. (13b) Dorsal fin origin posterior to that of anal fin; males with long filamentous extension on opercle...
CHARACIDAE (Corynopoma)

14b. Dorsal fin origin anterior to that of anal fin; males lacking opercular filament... ...15

15a. (14b) Mouth terminal or subterminal; dorsal fin with fifteen or more rays; sides with alternating light and dark vertical bars...
CHARACIDIIDAE (Elachocharax)

15b. Mouth superior; dorsal fin with fewer than fifteen rays; sides without vertical bars... LEBIASINIDAE (pyrrhulinines)

Anostomidae

The anostomids characteristically are fusiform, somewhat elongated fishes with conical heads, distinguished from other families by their small, nonprotractile mouths that usually have eight large incisors arranged in a single row in either jaw. The anterior nostril is usually tubular, and the gill membranes are often united to the isthmus (Géry 1977). According to Winterbottom (1980), this family together with the Chilodontidae, shares posteriorly replaced, cuspid pharyngeal teeth (not to be confused with the pharyngeal teeth of Cyprinidae). Roberts (1969), Géry (1977), Winterbottom (1980) and Vari (1983) have presented very different concepts of subfamilial divisions within the Anostomidae. The family comprises about ten genera, many of which are monotypic. All told, there are at least 100 described

species (Géry 1977), of which the largest by far is Leporinus, with some 70 nominal species (Vari 1983).

Most of the remaining taxonomic problems in this family involve the genus Leporinus, since Winterbottom's (1980) work has cleared up the situation in the subfamily Anostominae (comprising the genera Anostomus, Pseudanos, Gnathodolus, Sartor, and Synaptolaemus). Neither he nor Vari (1983) defined for the remaining genera, Abramites Abramoides, Laemolyta, Leporellus, Leporinus, Rhytiodus and Schizodon, although Winterbottom (1980) rejected Gery's (1977) subdivision into two subfamilies, Leporellinae for Leporellus, and Anostominae for all the rest.

The majority of anostomids are medium to large-sized omnivores or vegetarians that use their incisor-like teeth to clip aquatic vegetation, or as forceps to remove prey from crevices. A few anostomids have developed feeding specializations, these species are relatively smaller in size, are more elongated and have minute upturned mouths, often with bizarre dentition.

I have been able to identify twelve species from the Apure drainage, half of them members of the genus Leporinus. Most of the species' identifications are still tentative. For those that don't seem to agree with any described species, I have used code names.

Very little natural history information is available on anostomids in the Apure drainage. Most species are probably omnivorous, though some like Schizodon isognathus tend to be more herbivorous. All are probably egg scatterers, with no parental care. It is expected that most of the medium to large species spawn annually at the onset of the rains. The smaller ones probably spawn repeatedly during the wet season.

Key to the Apure Drainage Species of Anostomidae

This key is based in part on Winterbottom (1980) and Géry (1977), and will work only for specimens with adult pigmentation patterns. Since there is considerable size range variation in the family, defining "juvenile" size for all anostomids is not possible. Juvenile *Anostomus* for example, probably obtain adult coloration at a size of 20-30 mm SL, whereas juvenile *Leporinus* may not change to the adult pattern until they reach 100-120 mm. Juveniles all tend to look alike, and are marked with numerous vertical bars and rounded midlateral spots, that are gradually lost as the adult pattern is expressed.

1a. Caudal fin with oblique black bars; caudal fin densely scaled for most of its length; anterior nostril not tubular, proximate in position to the posterior nostril...
Leporellus vittatus (fig. 7)

1b. Caudal fin uniformly pigmented, without bars; caudal fin not scaled; anterior nostril usually tubular and well separated from posterior nostril... ...2

2a. (1b) Mouth superior (i.e. upturned) in adults... ...3
(Note: small juvenile *Schizodon isognathus* have superior mouths to a size of some 4 cm SL.)

2b. Mouth terminal or inferior in adults... ...5

3a. (2a) Pigmentation pattern comprising a large rounded black spot surrounded by lighter area located on center of each side, a smaller spot behind opercle and at base of caudal fin, dorsum crossed by 8-11 irregular narrow black bars, sides with horizontal rows of small spots... *Pseudanos irinae* (fig. 23)

3b. Pigmentation pattern not comprising a large rounded spot in center on the side, but rather of several wide black stripes or one wide black lateral stripe with several additional horizontal rows of small dots ...4

4a. (3b) Pigmentation pattern consisting of 10-11 horizontal rows of small dots on sides and a wide lateral stripe from opercle to tail (fig. 21) *Pseudanos gracilis* (fig. 21)

Winterbottom (1980) noted that this species exhibits two color phases. One is described here, whereas the other (not yet found in the Apure drainage) consists of 3-4 large rounded spots on mid sides with horizontal rows of small whitish spots. This is similar to the pattern of *P. irinae*; however, *P. gracilis* never has horizontal rows of black dots nor dark thin bars crossing the dorsum.)

4b. Pigmentation pattern consisting of wide black horizontal stripes separated by narrower white stripes, the widest black stripe centered on the side and extending from opercle to base of tail... *Anostomus ternetzi* (fig. 5)

5a. (2b) Teeth incisiform, with 2-5 cusps, some multicuspid teeth always present; anal fin usually with only seven branched rays... *Schizodon isognathus* (fig. 25)

5b. Teeth incisiform, without cusps or at most bifid, never multicuspid; anal fin with eight or more branched rays... ...6

6a. (5b) Anal fin usually with ten or more branched rays; body high and compressed, GBD 37-48% SL; a postventral keel present; headstanders that usually swim in a vertical position... *Abramites hypselonotus* (fig. 3)

6b. Anal fin usually with nine branched rays or fewer; body terete, not very compressed, GBD usually less than 30% SL; no postventral keel; swimming position horizontal... (genus Leporinus, 6 spp.)... ...7

7a. (6b) Body with about seven, wide, black vertical bars, the second usually forming a "Y"; base color yellowish...

Leporinus yophorus (fig. 19)

7b. Body without vertical bars, either plain, with horizontal stripes, or with large spots; base color variable... ...8

8a. (7b) Body with 4-5 wide black horizontal stripes, separated by narrower white or yellow stripes...

Leporinus cf striatus (fig. 17)

8b. Body without horizontal stripes, either plain with a small caudal spot or with large rounded spots on sides... ...9

9a. (8b) Adults with plain brown body and a small black spot at base of caudal fin... Leporinus sp. (fig. 13)

[lateral-line scales 42-44; predorsal scales 12-13; transverse scales 13-14]

9b. Adults with large black spots on sides of body... ...10

10a. (9b) Adults with five or more large black spots on sides of body, some along lateral midline, others both above and below these; mouth inferior... Leporinus cf maculatus (fig. 9)

10b. Adults with only two to four large rounded spots, all along lateral midline; mouth terminal or subterminal... ...11

11a. (10b) Adults usually with only two large rounded spots along lateral midline and no faint row of smaller spots on upper sides, although faint vertical saddles cross dorsum; head and body deeper and more robust; scales seldom spotted (one spot per scale); body

often decidedly higher in front of dorsal fin; eye smaller, in specimens over 100 mm SL its horizontal diameter less than half of interorbital width... *Leporinus friderici* (fig. 11) [lateral-line scales 38-40; predorsal scales 9-12; transverse scales 11-12]

11b. Adults usually with three or four large rounded spots along lateral midline plus a faint row of smaller spots on upper sides; scales often a spot (one per scale) arranged so as to form horizontal rows of dots; head and body more slender, not decidedly higher in front of dorsal fin; eye larger, in specimens over 100 mm SL its horizontal diameter is more than half interorbital width... *Leporinus* sp. "aguaro" (fig. 15) [lateral-line scales about 39; predorsal scales 10-12; transverse scales 11-12]

Species Accounts

Abramites hypselonotus (Günther) 1868

High-Backed Headstander - Cabezibajo

Fig. 3. Map: fig. 4. Couplet 6a.

Generic synonymy

Abramites Fowler 1906:331 (type species: *Leporinus hypselonotus* Günther 1868, by original designation); Vari & Williams 1987:89 (revision of genus).

Specific synonymy

Leporinus hypselonotus Günther 1868a:480 (type locality: Upper Amazon, Xeberos, Peru); Steindachner 1882:12 (Ciudad Bolivar, Venez.); Eigenmann 1909:323, 344 (Orinoco); Schultz 1944b:268 (Venez.).

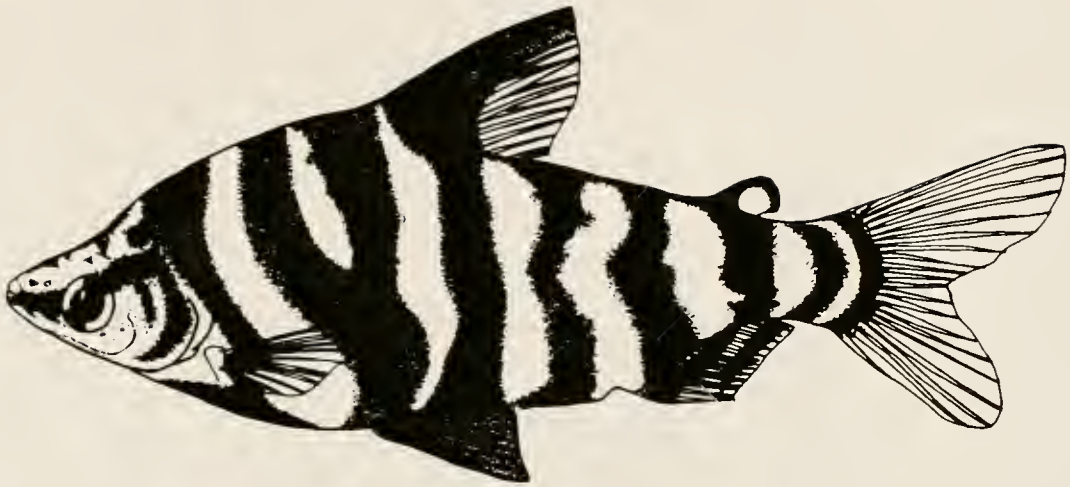


Figure 3. Abramites hypselonotus.

Leporinus solarii Holmberg 1887:222 (type locality: Argentina, Río Paraná).

Leporinus eques Boulenger 1896:34 misidentification of L. hypselonotus from Brazil).

Abramites hypselonotus Fowler 1906:331 (indicated as type species of Abramites; 1950:249 (synonymy); Mago L. 1970:75 (Venez.); Géry 1977:175 (key); Vari & Williams 1987:92 (synonymy, key, revision of genus).

Abramites microcephalus Norman 1926:92 (type locality: near mouth of Amazon River).

Abramites ternetzi Norman 1926:93 (type locality: Brazil, Matto (= Mato) Grosso, Sâo Luis and Descalvados.

Leporinus salarii Borodin 1929:288, (as a possible synonym of L. hypselonotus, specific name misspelled).

Leporinus nigripinnis Meinken 1935:193 (type locality: Argentina, Corrientes).

Abramites eques Fernández Y. 1950:116 (misidentification, Río Salinas, Venez.); Mago L. 1970:75 (Venez.).

Abramites solarii Ringuelet, Aramburu and Alonso de Aramburu 1967:213.

Abramites hypselonotus ternetzi Géry 1977:175 (Río Paraguay Basin).

Abramites hypselonotus hypselonotus Géry 1977:75 (Amazon and Orinoco basins).

Types. (designated by Vari & Williams 1987). Lectotype: BMNH 1867.6.13:40. Paralectotypes: BMNH 1867.6.13:41-42.

Comments. The genus Abramites is comprised of only two species. A. hypselonotus (Günther 1868), the only species in Venezuela, has 10-12 branched anal-fin rays and eight, irregularly-shaped bars on the sides

between the nape and the caudal peduncle. A. eques (Steindachner) 1878, has 13-14 branched anal-fin rays and only five bars on the body, the anteriormost situated under the dorsal fin (Vari & Williams 1987).

Etymology. ABRAM = from Abramis, a genus of similarly shaped fish, ITES = like; HYPSELO = raised or high, NOTUS = back.

Description

Illustrations. Fig. 3; Axelrod et al. 1971:F-2.10; Vari & Williams 1987:figs. 2-5.

Diagnosis. The unusual body shape and pigmentation pattern (fig. 3) are sufficient to identify this species. It is further distinguished by a terminal mouth, a deep, compressed body (GBD 37-48% of SL), and the presence of a postventral keel.

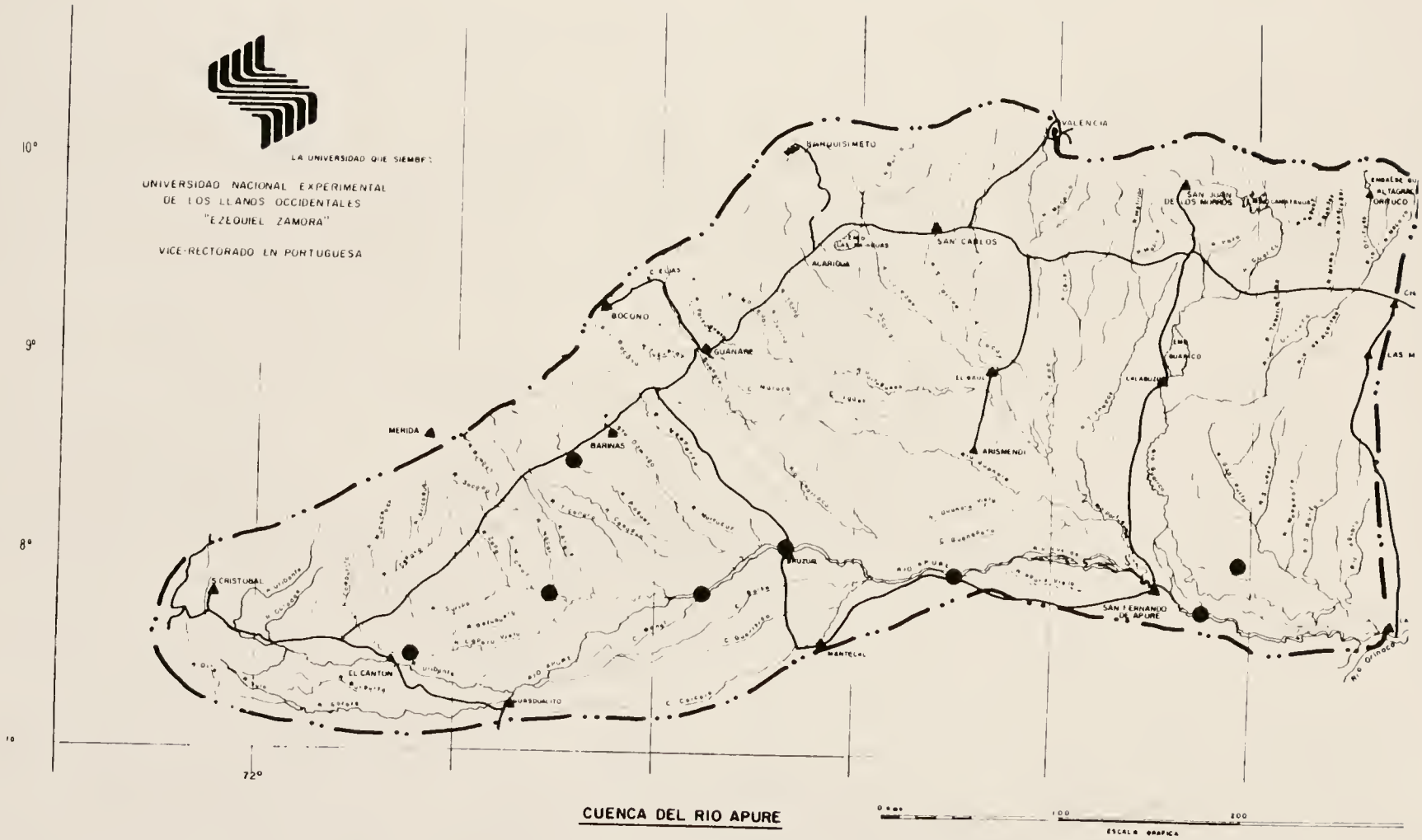
Size. It grows to about 130 mm SL.

Morphology. See Vari & Williams (1987). The conical head abruptly expands vertically behind the eye and the dorsal profile rises steeply from the nape to the dorsal-fin origin to give this species its characteristic high-backed appearance. The body is more compressed than in most anostomids.

Counts. DR 10-13 (up to three unbranched); AR 12-15 (up to three unbranched); PR 13-15; VR 8-9, 37-38 vertebrae.

Pigmentation. The body is tan or silvery with eight irregular vertical bars, the darkest and widest bar extends from the pelvic fins across body and onto the anterior dorsal fin. There is also a black stripe from the tip of the lower jaw through the eye, which continues obliquely upward toward the dorsum. The adipose fin is yellow and black, the caudal and pectoral fins are clear, and the anal fin is black.

Figure 4. Apure drainage distribution of *Abramites hypselonotus*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. A. hypselonotus occurs in the Amazon, Orinoco, Paraguay and lower Paraná basins (Vari & Williams 1987).

Apure distribution. Map: fig. 4. Although few specimens were collected, the localities range across the entire Apure drainage.

Habitat. This species was most frequently collected in habitats with aquatic vegetation in quiet sidewaters of large whitewater rivers in the low llanos. It swims in a head down position, often aligning itself with the stems of plants.

Abundance. UNCOMMON.

Number of specimens examined. 28 from 14 collections.

Food. OMNIVORE. Its diet includes aquatic invertebrates, as well as vegetable matter.

Reproduction. Probable strategy: rl.

Importance. This is a highly valued ornamental.

Anostomus ternetzi Fernández Y. 1949

Red-Mouthed Headstander - Cabezibajo Bocaroja

Fig. 5. Map fig. 6. Couplet 4b.

Generic synonymy

Anostomus Gronow 1763:122 (description and figure, no species mentioned, work not accepted by ICZN).

Anostomus Scopoli 1777:451 (no species mentioned, but since this work was based on Gronow the type species is that illustrated by Gronow 1756, which is Salmo anostomus Linnaeus).

Anostoma Rafinesque 1815 (alternative spelling).

Mormyrhynchus Swainson 1839:186, 291 (type species: Mormyrhynchus gronovii Swainson = Salmo anostomus Linnaeus, by monotypy).

Figure 5. Anostomus ternetzi.

Histriodromus Gistel 1848:8 (type species: Salmo anostomus Linnaeus, by monotypy).

Pithecocharax Fowler 1906:319 (type species: Salmo anostomus Linnaeus, by original designation, this name was proposed as a substitute for Anostomus Walbaum 1792).

Specific synonymy

Anostomus ternetzi Fernández Y. 1949:293 (type locality: Orinoco River System); Knöppel 1972:231 (diet).

Anostomus anostomus (non Linnaeus); Myers 1950:184 (part).

Types. Holotype: Museo de Ciencias Naturales de Caracas 46001. Paratypes: MCNC 46002; CAS 20093(1), 20094(1), 20095(4), 20096(1).

Etymology. ANO = upturned, STOMUS = mouth; TERNETZI = for Carl Ternetz.

Description

Illustrations. Fig. 5; Axelrod et al. 1971:F-40.11 - 40.12; Géry 1977:188; Winterbottom 1980:81 fig. 17.

Diagnosis. A. ternetzi is separable from Leporinus by the superior mouth. The color pattern is distinctive for the species. The white stripe that extends from between nostrils along the dorsal midline to the dorsal-fin origin in this species, is dark in A. anostomus, a species that occurs in other parts of Venezuela.

Size. It grows to about 100 mm SL.

Counts. This species has three branchiostegal rays instead of the four usually found in other Anostomus species. DR 12-13; AR iii7-iii8; PR i13-i15; VR i8; LS 39-42; PDS 11-14; CPS 16.

Pigmentation. The basic pigmentation pattern consists of three wide black horizontal stripes separated by narrower white zigzag stripes.

The widest black stripe is situated at midside and extends from the opercle to the base of the tail. Another starts at the pectoral-fin insertion and extends back to the lower part of the caudal peduncle. There is a narrow black stripe situated on either side of the narrow white stripe that runs along the ventral midline, and another wide black stripe on either side of the white stripe that extends from between the nostrils to the dorsal fin origin. In many individuals the black (or dark brown) pigment uniformly covers most of the dorsum, although it is sometimes divided into several rows of dots by lighter areas. Fins that are normally reddish in life, would appear clear in preserved specimens.

Distribution and Natural History

Range. This species occurs in the Amazon and Orinoco basins, and in Guyana.

Apure distribution. Map: fig. 6. It is known only from northern Apure state, and the Aguaro-Guariquito system.

Habitat. It is found in black or clearwater streams with abundant aquatic vegetation, in the sandy-soiled areas of northern Apure state and western Guárico.

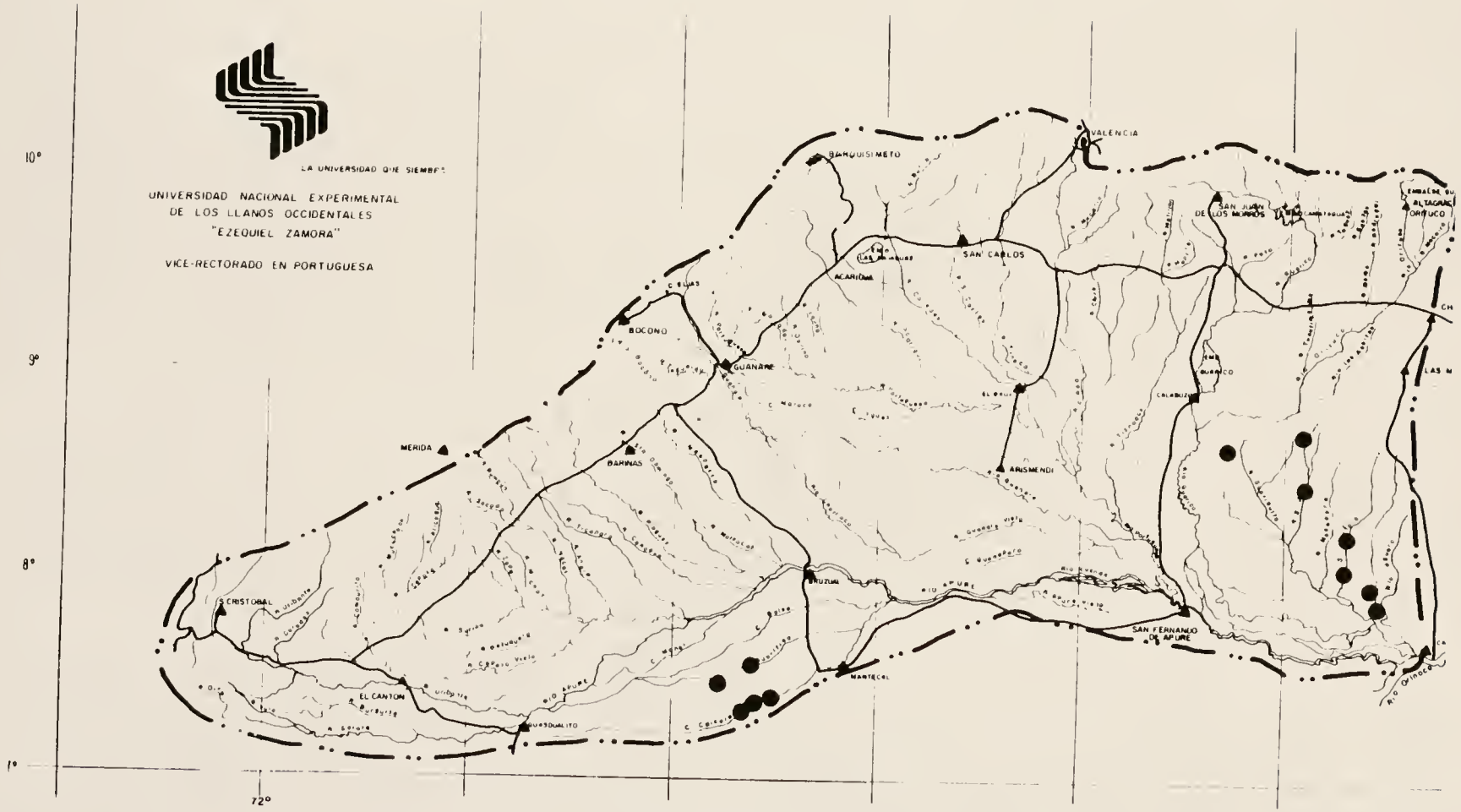
Abundance. UNCOMMON.

Number of specimens examined. 69 from 19 collections.

Food. OMNIVORE. This fish probably feeds on vegetable material as well as aquatic insects. It swims head down, and presumably feeds in this position amidst aquatic vegetation.

Reproduction. Probable strategy: r1. Winterbottom (1980) noticed some sexual dimorphism, in that males have a greater caudal peduncle depth. Sterba (1972) stated that the similar *A. anostomus* is territorial. Axelrod et al. (1971) stated that in *A. anostomus* the pair quivered

Figure 6. Apure drainage distribution of *Anostomus ternetzi*.



CUENCA DEL RIO APURE

side by side, and expelled a large number of eggs all over the glass, plants and the bottom of the aquarium. Fry were slender, about 15 mm long, and swam in a normal horizontal position.

Importance. Ornamental.

Leporellus vittatus (Valenciennes) 1849

Stripe Tailed Leporellus - Mije de Cola Rayada

Fig. 7. Map fig. 8. Couplet 1a.

Generic synonymy

Leporellus Lütken 1874b:129 (type species: Leporinus pictus Kner, by monotypy).

Leporinodus Eigenmann 1922:116 (type species: Leporinodus retropinnus Eigenmann 1922, by original designation, (described in footnote).

Specific synonymy

Leporinus vittatus Valenciennes in Cuvier & Valenciennes 1849:59 (type locality: Río Amazonas).

Leporellus vittatus Lütken 1874b:129; Fowler 1950:253 (synonymy); Géry 1977:151 (diagnosis).

Leporinodus vittatus Eigenmann 1922:117.

Leporinus pictus Kner 1859:172, pl. 8, fig. 19 (type locality: Orissanga, Est. de São Paulo).

Salmo cagoara Natterer in Kner 1859:172 (name in synonymy).

Leporinus maculifrons Reinhardt in Lütken 1874b:201 (name in synonymy).

Leporellus timbore Eigenmann 1922:117 (type locality: Río das Velhas).

Comments. Géry (1977) listed seven forms in this genus, of which he listed (without explanation) L. maculifrons, L. timbore, and L. cartledgei as synonyms of L. pictus. None are well known, and a revision of the genus is necessary before any further comments can be made

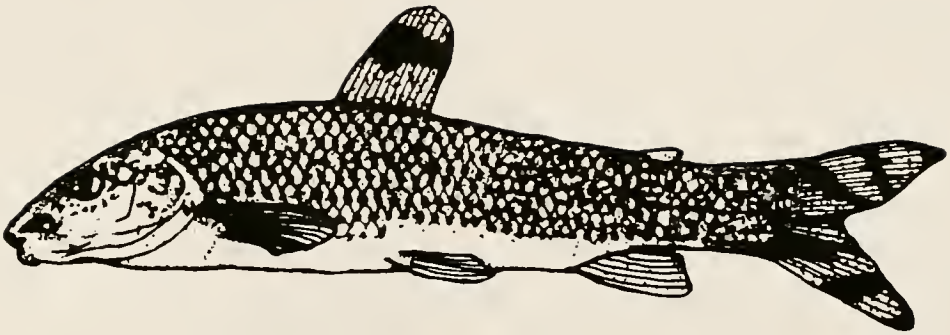


Figure 7. Leporellus vittatus.

about synonymies. I have used the synonymy of Fowler (1950) here, but additional study may change these.

Etymology. LEPORELLUS = like a rabbit, referring to the teeth; VITTATUS = spotted.

Description

Illustrations. Fig. 7; Géry 1977:153.

Diagnosis. This is the only anostomid with a scaled, obliquely barred caudal fin. The pigmentation pattern of the body (fig. 7) is also distinctive.

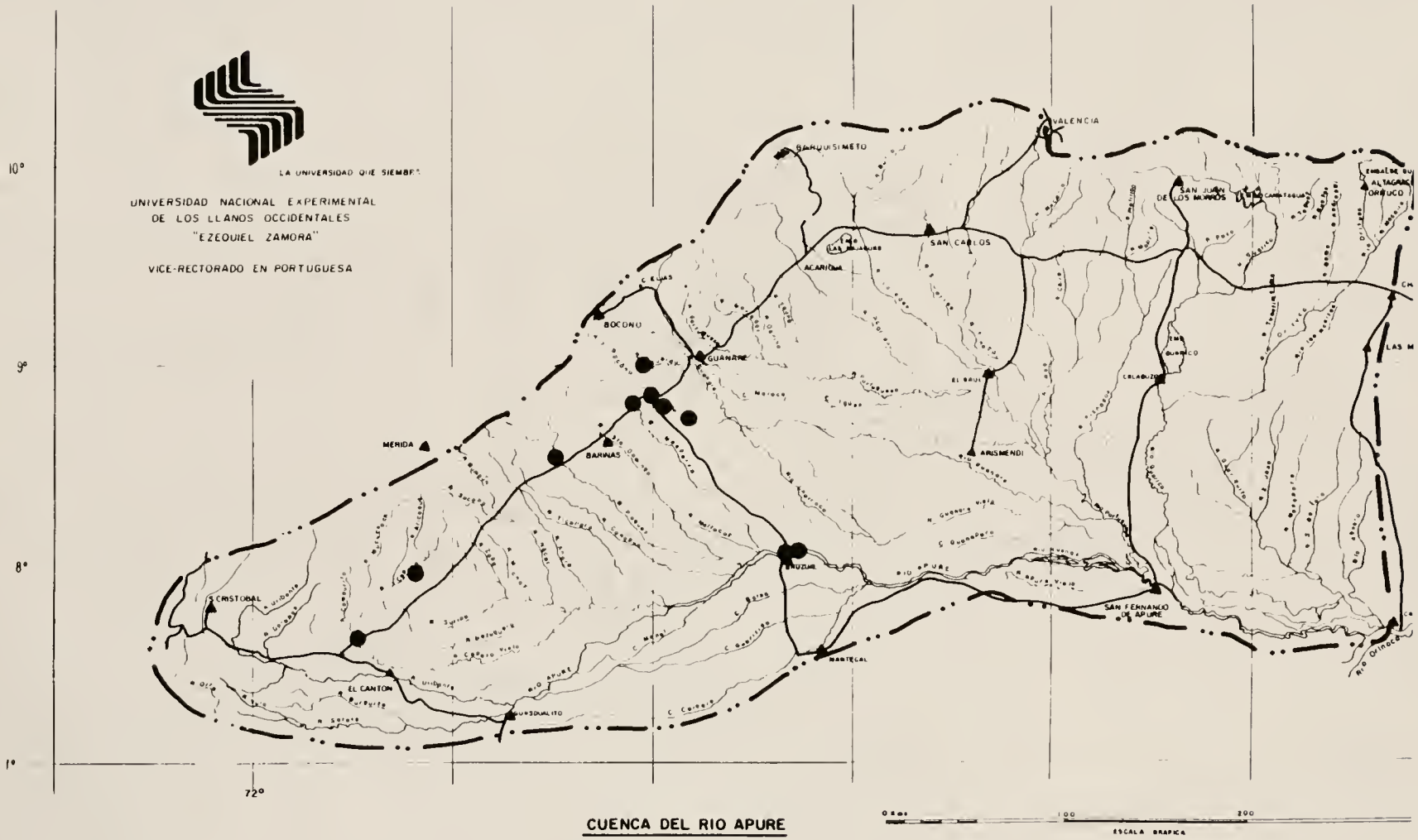
Size. It grows to at least 200 mm SL.

Morphology. It is elongate with a large head and eye. The mouth is subterminal with the lower lip reverted to form a wide fold. The gill membranes are joined to the isthmus. The nostrils are proximate, and not tubular (unusual in this family). The caudal fin is completely scaled.

Counts. DR 13; AR 10-11; PR 16-17; VR i8; LS 42; PDS 12-13; CPS 16-17; TS 11-12.

Pigmentation. The base color of the body is yellow-brown in life. The white tail has a black stripe through the central rays, and two black oblique bars in each lobe. The top of the head, dorsum, and upper sides are heavily spotted, but the belly is white. The spots on the sides (one per scale) are arranged in nine or ten horizontal rows. The sides have two white stripes devoid of spots that continue posteriorly onto the tail. The dorsal fin is white with a large black distal blotch on its first rays, and a row of black spots nearer base. The pectoral and pelvic fins are whitish to clear. The anal fin is white with a central black blotch.

Figure 8. Apure drainage distribution of *Leporellus vittatus*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. The range is not well documented but it probably occurs in most of the Andes in Venezuela and Colombia. There are reports of this species from the Guyana Shield in Venezuela, but I have not seen specimens. The form there may represent a different species.

Apure distribution. Map: fig. 8. It has been found only in the western portion of the Apure drainage, usually in the Andean foothills.

Habitat. It lives in clear, clean, fast-flowing mountain streams. Juveniles have been taken at Bruzual in the quiet edges of the Apure River from aquatic vegetation. They perhaps were washed out of the mountains, or the reproductive cycle might include a downstream phase with later upstream migration.

Abundance. UNCOMMON.

Number of specimens examined. 49 from 16 collections.

Food. OMNIVORE. It feeds on both insects and vegetable matter. I observed several individuals biting at rocks in the clear waters of the upper Río Caparo, presumably selecting items from the epibenthos.

Reproduction. Probable strategy: r2.

Importance. It has great potential as an ornamental.

Leporinus cf maculatus Müller & Troschel 1844

Spotted Leporinus - Mije Pintado or Cabeza de Manteco

Fig. 9. Map: fig. 10. Couplet 10a.

Generic synonymy

Leporinus Spix in Agassiz 1829:65 (type species: Leporinus fasciata Agassiz, by monotypy).

Hypomasticus Borodin 1929:287 (type species: Leporinus mormyrops Steindachner 1875, designated by Fowler 1950:228).

Figure 10. Leporinus cf maculatus.

Specific synonymy

Leporinus maculatus Müller & Troschel 1844:86 (type locality: Guyana); 1845:11 (rivers of Guyana); Eigenmann 1912a:305 (redescription); Fowler 1950:237 (synonymy); Géry 1977:166 (key, discussion of many-spotted Leporinus).

Leporinus megalepis Günther 1863:443 (type locality: Essequibo River, Guyana).

Leporinus marcgravii Lütken 1874b:130 (type locality: Río Velhas and tributaries).

Comments. The counts for Apure drainage specimens are consistently higher than those given by Eigenmann (1912) for specimens from Guyana, either because of a more inclusive counting method, or because different species are involved. Géry (1977) discussed the complex taxonomic problems of the many-spotted Leporinus species. He stated that in current usage both aquarists and ichthyologists have confused L. pellegrini with L. maculatus, and that the name L. maculatus has been applied to at least two very different species. I follow him in using L. maculatus for the species with a ventral mouth. He placed this species in the subgenus Hypomasticus.

Etymology. LEPO = rabbit, RINUS = snout; MACULATUS = spotted.

Description

Illustrations. Fig. 9; Eigenmann 1912:pl. 43, fig. 2; Axelrod et al. 1971:F377.00; Géry 1977:166; Román 1985:141.

Diagnosis. The pigmentation pattern is distinctive (fig. 9). This is the only Leporinus with five or more large spots on the sides. The ventral mouth is also unique.

Size. It grows to at least 200 mm SL.

Morphology. The head length is about equal to the greatest body depth. The interorbital width is less than the snout length.

Counts. DR ii10; AR ii9; PR i14-i16; VR i8; CPS 16; LS 38-40; TS 11-12 5-6 above, and 5 below lateral line.

Measurements. HL = 22% SL; GBD = 27-33% SL (Eigenmann 1912 for Guyanan specimens). In Apure specimens, GBD and HL = 24-26% SL; EYE = 50-66% HL, IO = 43-55% HL, and SNT = 20-24% HL.

Pigmentation. The body is marked with several large ovate black spots along the lateral midline, and on the upper and lower sides This is a pattern similar to that of most juvenile anostomids, but in this case it has been retained in the adult.

Distribution and Natural History

Range. It occurs in the Guianas and in the Orinoco Basin.

Apure distribution. Map: fig. 10. It is known only from the Aguaro-Guariquito system in the easternmost portion of the Apure drainage.

Habitat. It occurs in clear and blackwater creeks of the upper Aguaro River system, in sandy bottomed savanna streams with abundant aquatic vegetation.

Abundance. RARE.

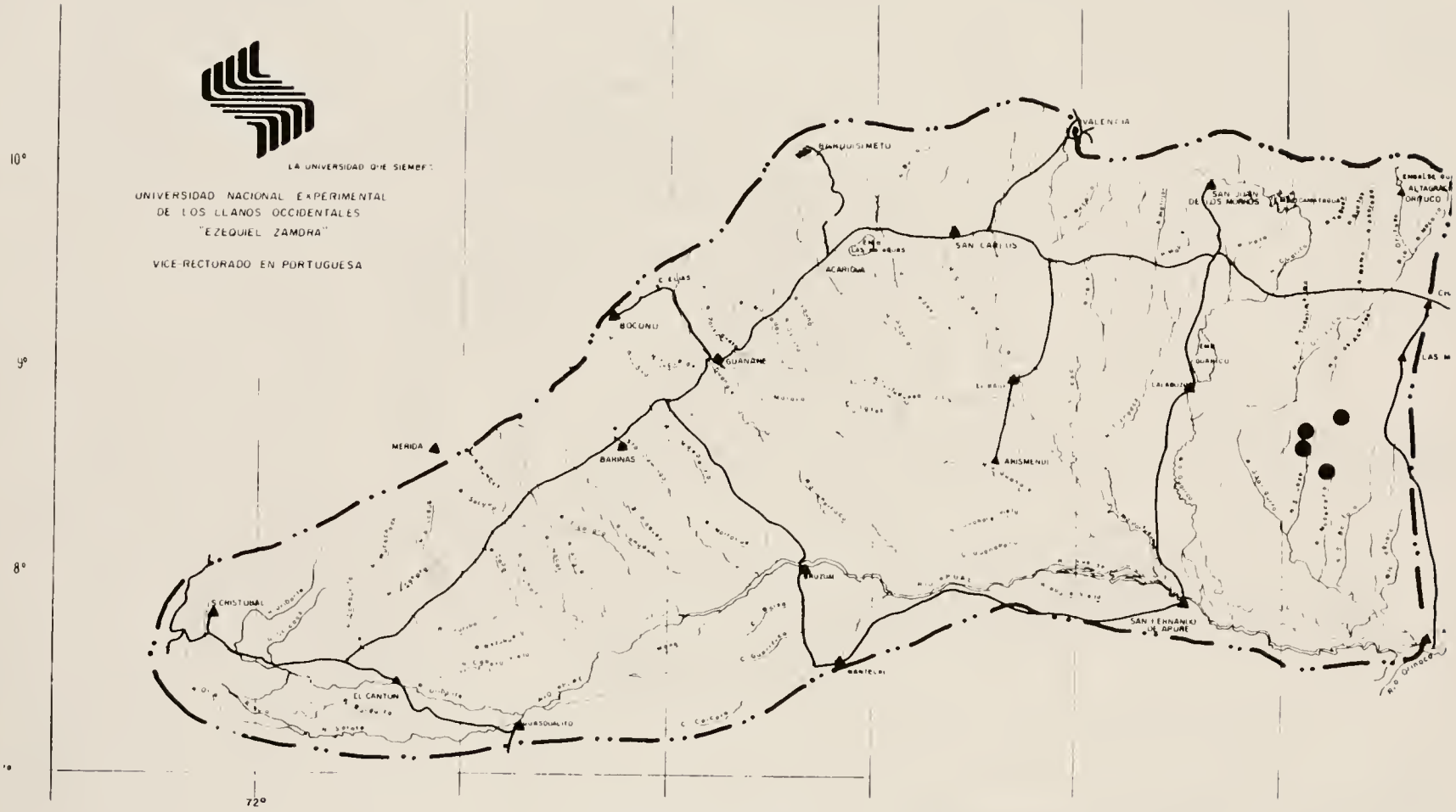
Number of specimens examined. 6 from 4 collections.

Food. HERBIVORE. It is probably mainly herbivorous, though occasionally aquatic insects may be included in the diet.

Reproduction. Probable strategy: r2. It is probably an egg scatterer that synchronizes its annual reproductive effort with the beginning of the rainy season. Axelrod et al. (1971) reported that this species spawned in aquaria, scattering eggs all over, and then eating them if not removed.

Importance. Ornamental.

Figure 10. Apure drainage distribution of *Leporinus* cf *maculatus*.


LA UNIVERSIDAD QUE SIEMBRA
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
GUANARE
MERIDA
BARINAS
ANISMENDI
SAN FERNANDO DE APURE
SAN CRISTOBAL
EL CANTON
SAN JUAN DE LOS MORROS
ALTAGRACIA DE ORITUCO
LAS M
RIO ORINOCO
RIO APURE
CUENCA DEL RIO APURE
ESCALA GRAFICA

Leporinus friderici (Bloch) 1794

Leporinus - Mije

Fig. 11. Map: fig. 12. Couplet 11a.

Specific synonymy

Salmo friderici Bloch 1794:94, pl. 378 (type locality: Surinam).

Leporinus friderici Müller & Troschel 1844:87; 1845:11; Eigenmann & Allen 1942:305 (Venezuela); Fowler:1950:233 (synonymy).

Leporinus fridericii Kner 1859:170 (misspelling).

Leporinus frederici Valenciennes in Cuvier & Valenciennes 1849:25 (misspelling).

Leporinus fradericii Goeldi 1898:482 (misspelling).

Curimatus frederici Perugia 1891:641.

Curimatus acutidens Valenciennes 1847:9, pl. 8, figs 1-1a (type locality: South America)

Leporinus megalepis (non Günther 1863) Günther 1864:307 (part).

Leporinus leschenaultii Valenciennes in Cuvier & Valenciennes 1849:30, pl. 635 (type locality: Mana); Peters 1877:472 (Calabozo, Venezuela); Eigenmann & Eigenmann 1891:51 (Calabozo, Venezuela); Pellegrin 1899:157 (Apure River, Venezuela).

Comments. Identification of species in the L. friderici group is difficult, see Géry (1977) and Garavello (1988) for a brief outline of the problem. Apure specimens resemble L. subniger Fowler 1943 from Florencia, Colombia in the Andean piedmont, and both of these seem quite similar to L. bahiensis Steindachner 1875 from Brazil.

Etymology. FRIDERICI = probably named for the German monarch Frederick the Great (1712-1786).

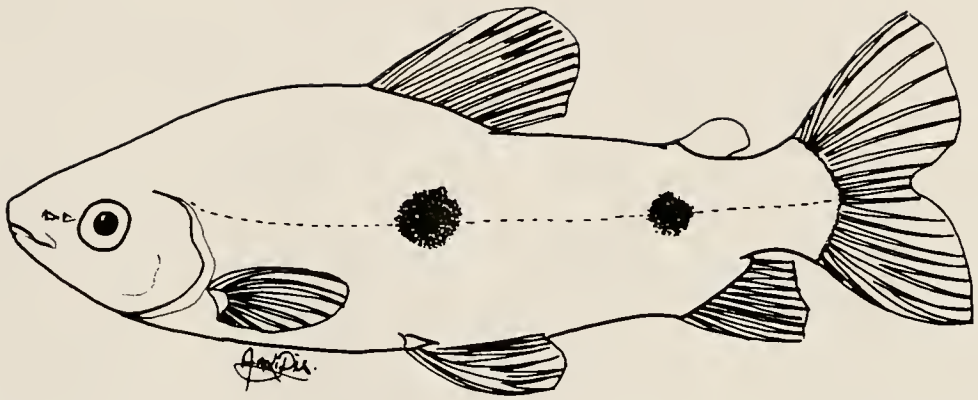


Figure 11. Leporinus friderici.

Description

Illustrations. Fig. 11; Eigenmann 1912:pl. 63 fig. 4; Axelrod *et al*. 1971:F-376.00; Géry 1977:168.

Diagnosis. The pigmentation pattern is distinctive (fig. 11). Adults usually have only two large spots on the sides. This species is very similar to *Leporinus* sp. "aguaro," but that form usually has three large spots on the sides, and has a relatively larger eye (the eye diameter is more than half of the interorbital width vs less than half in *L. friderici*. Faded specimens of *L. friderici* (without spots) are similar to "*Leporinus* sp.," but the latter has much wider lips, and more lateral-line scales (42-44 vs 38-40). *L. boehlkei* Garavello 1988 has fewer lateral-line scales (35-36), and fewer circumpeduncular scales (12 vs 16).

Size. It reaches at least 350 mm SL.

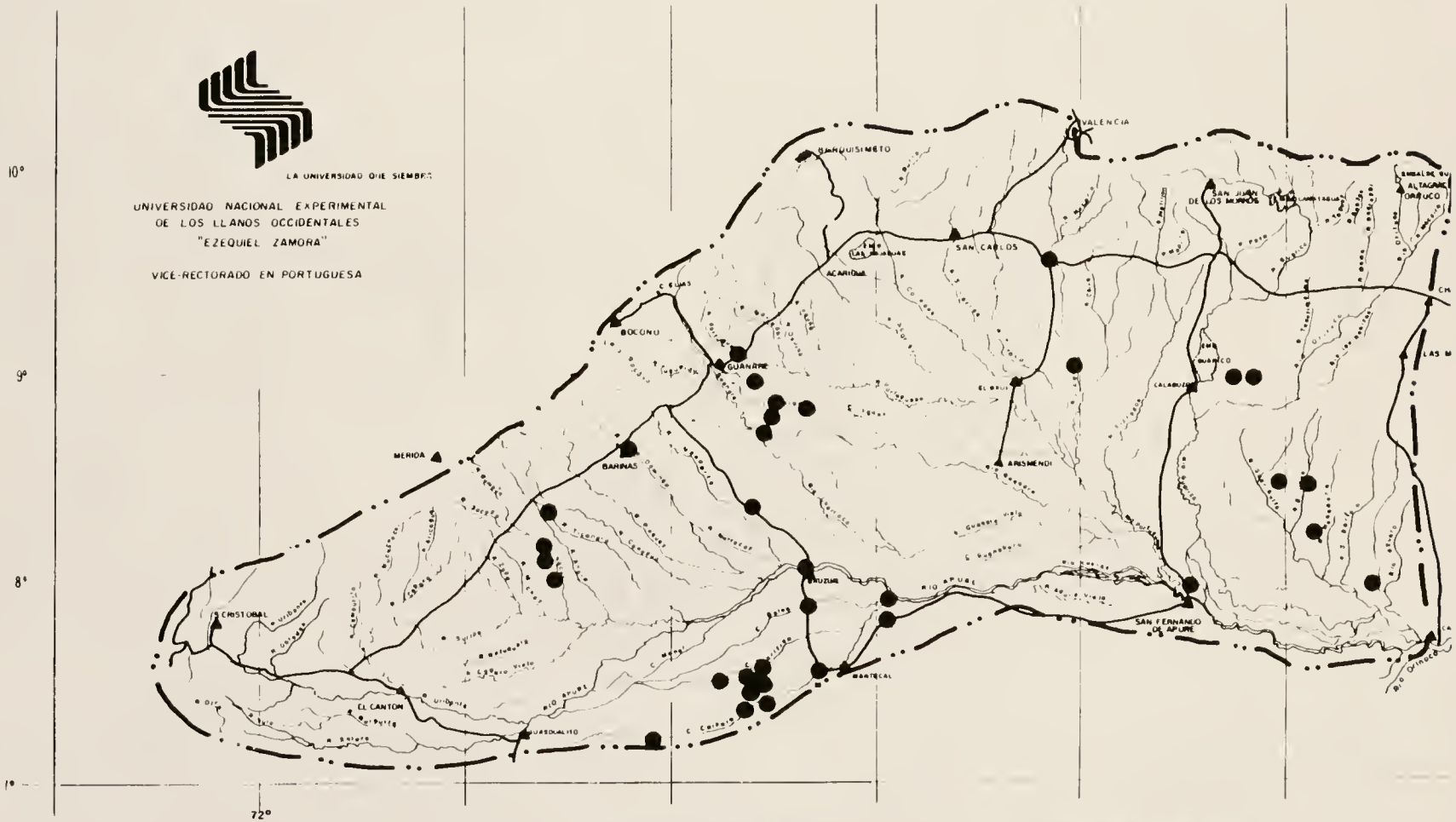
Morphology. This is a very robust, deep-bodied *Leporinus* with a stocky appearance. The mouth is terminal.

Counts. DR ii10; AR ii9; PR i14-i16; VR i8; LS 38-40; PDS 9-12; CPS 16; TS 11-12; teeth 3-3 on premaxilla, middle incisors bifid, the others strangely curved; 3-4 teeth on dentary, the last one tiny and next to base of last big tooth.

Measurements. GBD 32-36% SL.

Pigmentation. The dorsum is grayish, and crossed by about 12-15 faint vertical bars and the ventrum is light tan. The sides are brown, with at least two large, rounded black spots, the first spot under dorsal fin base, the second just anterior to the adipose fin. Sometimes there is an additional spot at the base of the caudal fin. The fins, especially the anal, are dusky and heavily pigmented on the membranes. The adipose fin is often edged in black.

Figure 12. Apure drainage distribution of *Leporinus friderici*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins, and the Guianas.

Apure distribution. Map: fig. 12. It is common throughout the piedmont and llanos.

Habitat. It lives in a wide variety of streams and rivers from both white and blackwater habitats.

Abundance. COMMON.

Number of specimens examined. 230 from 64 collections.

Food. OMNIVORE. It feeds mostly on aquatic plants, but seeds and carrion (fish flesh) are also included in its diet (K. Winemiller pers. com.).

Reproduction. Probable strategy: r2. This species migrates downstream shortly after the first rains of the season. Spawning probably takes place in midriver, in a fashion similar to *Prochilodus mariae*.

Migrations. This fish is known to accompany *Prochilodus mariae* on annual migrations from the lowland floodplain habitats upstream to piedmont and montane streams at the beginning of the dry season, and thence back downstream when the seasonal rains begin.

Importance. It is of minor importance as a commercial species.

Leporinus sp.

Fatlip Leporinus - Mije

Fig. 13. Map fig. 14. Couplet 9a.

Comments. This may be a new species. Its plain coloration and meristic characters don't agree well with any described species.

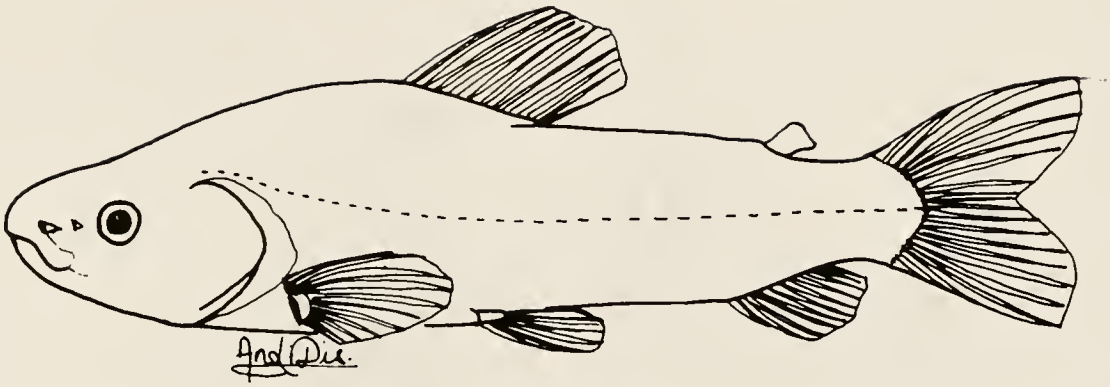


Figure 13. Leporinus sp.

Description

Illustrations. Fig. 13.

Diagnosis. This fish is quite plain, usually brown when adult, with a small black spot at the base of the tail (fig. 13). The lip is much thicker and more gently curved than in the similar *L. friderici*. It has a more slender body as well. The lateral-line scale count of 42 to 44 is higher than for most other Apure drainage *Leporinus* species, in which the number usually does not exceed 40.

Size. It reaches at least 250 mm SL.

Counts. DR ii10; AR ii9; PR i14-i18; VR i8; LS 42-44; PDS 12-13; CPS 16; TS 13-14.

Measurements. GBD 26-30% SL in specimens above 90 mm SL.

Pigmentation. The body in adults is plain brown with a small spot at the base of the caudal fin. Smaller specimens may have two or three spots on the sides.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 14. It occurs throughout the piedmont and llanos.

Habitat. It lives in muddy (whitewater) streams and rivers.

Abundance. COMMON.

Number of specimens examined. 81 from 25 collections.

Food. OMNIVORE. It is probably mostly vegetarian, but undoubtedly includes some aquatic invertebrates in its diet.

Reproduction. Probable strategy: r2.

Migrations. It makes annual migration similar to those of *Prochilodus mariae*, and often accompanies that species during the

Figure 14. Apure drainage distribution of *Leporinus* sp.

CUENCA DEL RIO APURE

"ribazón" (the spectacular annual upstream migration that begins with the onset of the dry season in October or November).

Importance. It is of only minor commercial importance.

Leporinus sp. "aguaro"

Leporinus - Mije

Fig. 15. Map fig. 16. Couplet IIb.

Comments. This species is similar to the species I have identified as L. friderici, and could turn out to be the "real" L. friderici. If that is the case, the species I have identified as L. friderici is probably new. The original descriptions don't provide adequate information to make a certain determination. L. friderici was described from Surinam, presumably from blackwater rivers typical of the Guyana Shield and coastal drainages. Leporinus sp. "aguaro," is apparently restricted to similar habitats in the Apure drainage.

Description

Illustrations. Fig. 15.

Diagnosis. This species can be distinguished by pigmentation pattern (fig. 15), which consists of three to four large spots along the lateral midline plus a faint row of smaller spots above them on the upper sides. It has fewer lateral scales (39 vs 42-44) than Leporinus sp., and a relatively larger eye (the eye diameter greater than half of the interorbital width) than L. friderici (less than half the interorbital width).

Size. It grows to at least 200 mm SL.

Morphology. The snout length is about equal to the interorbital width.

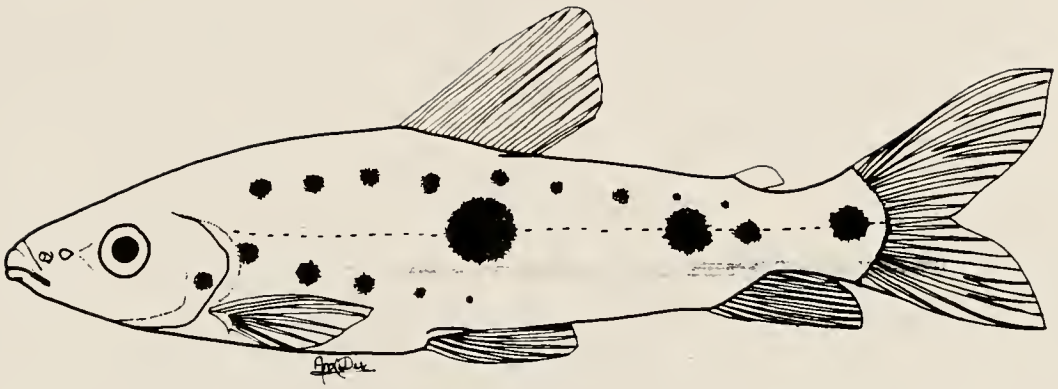


Figure 15. Leporinus sp. "aguaro".

Counts. DR ii10; AR ii9; PR i15-i16; VR i8; LS 37-39; PDS 10-12; CPS 16; TS 11-12, with 5-6 scales above and five below the lateral line.

Measurements. GBD 29-32% SL; HL 28-31% SL; EYE in HL 22-34%, in SNT 53-96%, in IO 54-86% (the large variation in eye diameter is due to allometry, juveniles have relatively larger eyes).

Pigmentation. The body is brown, darkest on the dorsum and becomes gradually whiter towards the belly. The sides are marked with three or four large black rounded spots, the first under the posterior dorsal-fin base, the second just anterior to the adipose fin, the third under the adipose fin, and the fourth on the caudal peduncle. Another series of seven smaller spots is situated above these on the upper sides. Each scale has a dark spot on its margin, resulting in up to 10 horizontal rows of dots; in some specimens the dark pigment completely outlines each scale, forming a net-like pattern.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 16. It is known only from the Aguaro River system.

Habitat. It occurs in blackwater streams and rivers.

Abundance. RARE.

Number of specimens examined. 3 from 3 collections.

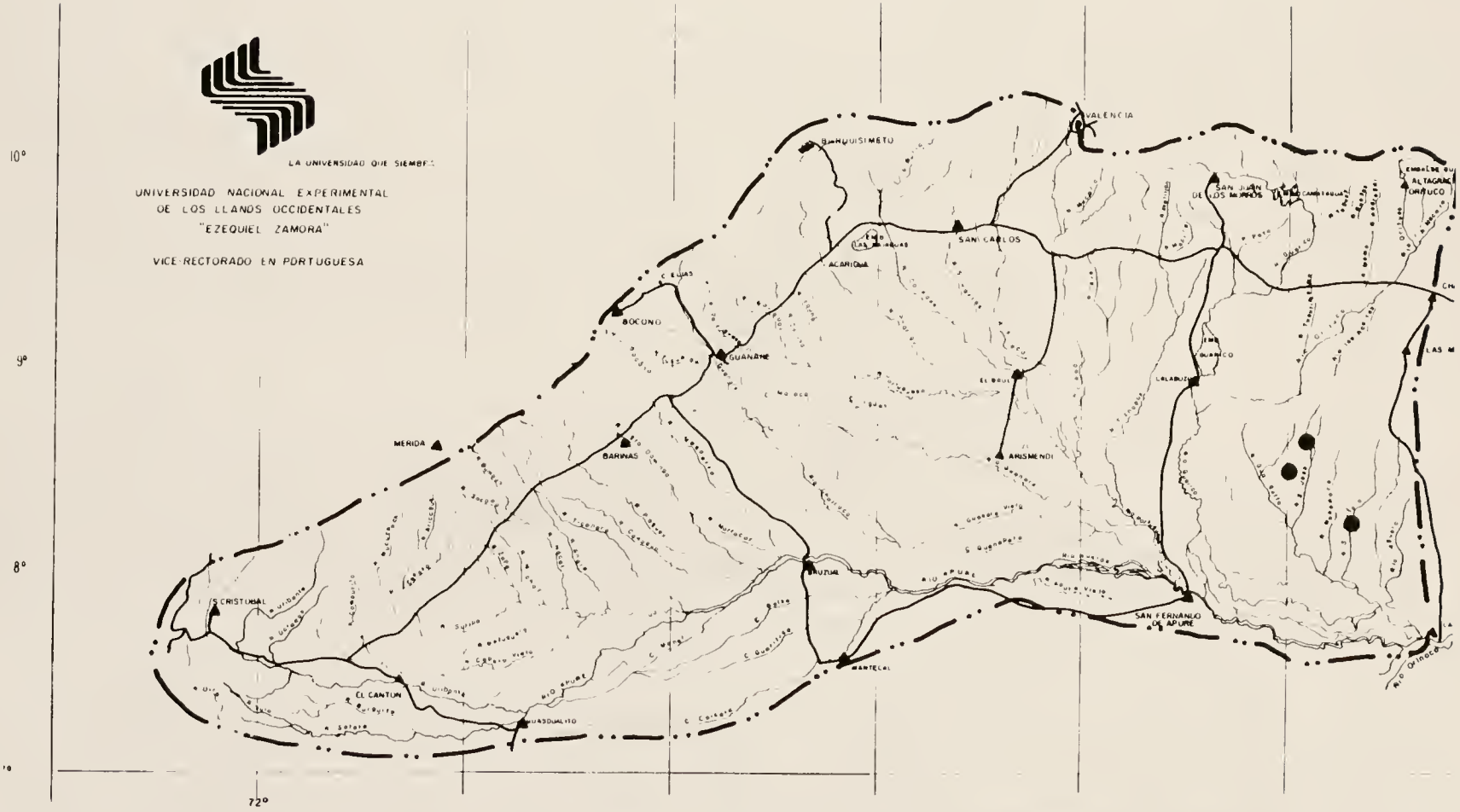
Food. OMNIVORE. It is probably mostly herbivorous.

Reproduction. Probable strategy: r2.

Migrations. They are probable, but not documented.

Importance. It is potentially valuable as an ornamental.

Figure 16. Apure drainage distribution of *Leporinus* sp. "aguaro".



CUENCA DEL RIO APURE

Leporinus cf striatus Kner 1859

Striped Leporinus - Mije Rayado

Fig. 17. Map fig. 18. Couplet 8a.

Specific Synonymy

Leporinus striatus Kner 1859:171 pl. 8, fig. 18 (type locality: Orissanga, Río Paraná and Caicara Mato Grosso, Brazil); Pellegrin 1899:157 (Apure River, Venezuela); Géry 1977:170 (key).

Ledorinus (error) striatus Bertoni 1939:54 (Paraguay).

Salmo tiririca Natterer in Kner 1859:172 (?based on same type as L. striatus Kner).

Comments. Since L. striatus was described from southern Brazil, it is doubtful that the same species is present in the Apure drainage. Fowler's illustration (1950) depicts a fish with only two stripes on the side. I have examined the holotype (FMNH 53366) of the similar L. arcus Eigenmann 1912, which was described from British Guiana, and which would perhaps be more likely to occur in Venezuela. It is, however, a different-looking fish with only four stripes on either side (vs five in Apure specimens). In addition the dorsum in the L. arcus holotype is uniformly dark, and though the pigment may have obscured a stripe that may have originally been present, none is shown in the figure of the holotype (Eigenmann 1912:pl. 62, fig. 3). The holotype has 36 lateral-line scales (vs 38 in Apure specimens) and ten transverse scales (vs 12). Finally, specimens of the type series of L. arcus greatly exceed the maximum recorded size for L. striatus. These data strongly suggest that the Apure specimens are not L. arcus. I suspect that the Apure drainage form is undescribed, but this cannot be finally resolved until it can be compared with fresh material from the type localities of L. arcus and L. striatus.

Figure 17. Leporinus cf striatus

Etymology. STRIATUS = striped.

Description

Illustrations. Fig. 17; Axelrod et al. 1971:F-378.00; Román 1983:99.

Diagnosis. The color pattern of black stripes over a yellowish background (fig. 17) is unique for Apure drainage anostomids. In this regard it is superficially similar to *Anostomus ternetzi*, but that species has a superior mouth and is much more slender and elongate.

Size. It is seldom found over 100 mm SL, but can reach 175 mm.

Morphology. This is a robust, stocky fish. The horizontal diameter of the orbit is longer than the snout length, but slightly less than the interorbital width. The mouth is subterminal.

Counts. DR ii10; AR ii8; PR i14; VR i8; LS 38; PDS 10; CPS 16; TS 12; teeth 3-3, 3-3 or 4-4 (if four the last very small), the teeth are curved incisors with brown tips, not truly cuspid but with irregular margins. The center of the roof of the mouth has a bulbous papillose projection.

Measurements. GBD about 29% SL; HL 36% SL; EYE 36% HL. IO 39% HL.

Pigmentation. Juveniles up to about 40 mm SL show vertical banding instead of the typical adult pattern of horizontal light and dark stripes. They also have a jet-black adipose fin with a light center, a dark crescent along base of tail with darker dot at midpoint, and a black anal fin. Juveniles also lack pigment on the fontanel and have about three vertical stripes anterior to the dorsal fin. At 19 mm SL one juvenile had only vertical barring, but another specimen of 37 mm SL had the beginnings of horizontal stripes.

Adults have a black line along the dorsal midline of the body in front of the dorsal fin, but the dorsal midline of the head has a white

stripe. They have five additional dark stripes on either side, the first of which extends from the occiput along the uppermost sides and back to the adipose fin. The second extends from the snout, back above the eye to the uppermost caudal-fin base. A third extends from the snout through the eye across the opercle and back along the midside to midtail. The fourth extends from the pectoral-fin base (which is dark dorsally near its base) back to the anal fin and onto the lower caudal peduncle. The fifth stripe is faint and extends from the lower pectoral-fin base to the pelvic-fin base. The adipose and anal fins are black, the other fins white, tan, or transparent.

Distribution and Natural History

Underwater observations confirm that this species usually travels in schools, as do most *Leporinus*. However, since they occur over rocky substrates where seines are easily avoided, most of our collections are of very few specimens.

Range. It has been reported from the Orinoco, Amazon and Paraná basins.

Apure distribution. Map: fig. 18. It is most common in the Andean piedmont and streams in the upper llanos.

Habitat. *L. striatus* is most commonly found in clear streams and rivers, with fast currents and rocky substrates.

Abundance. COMMON.

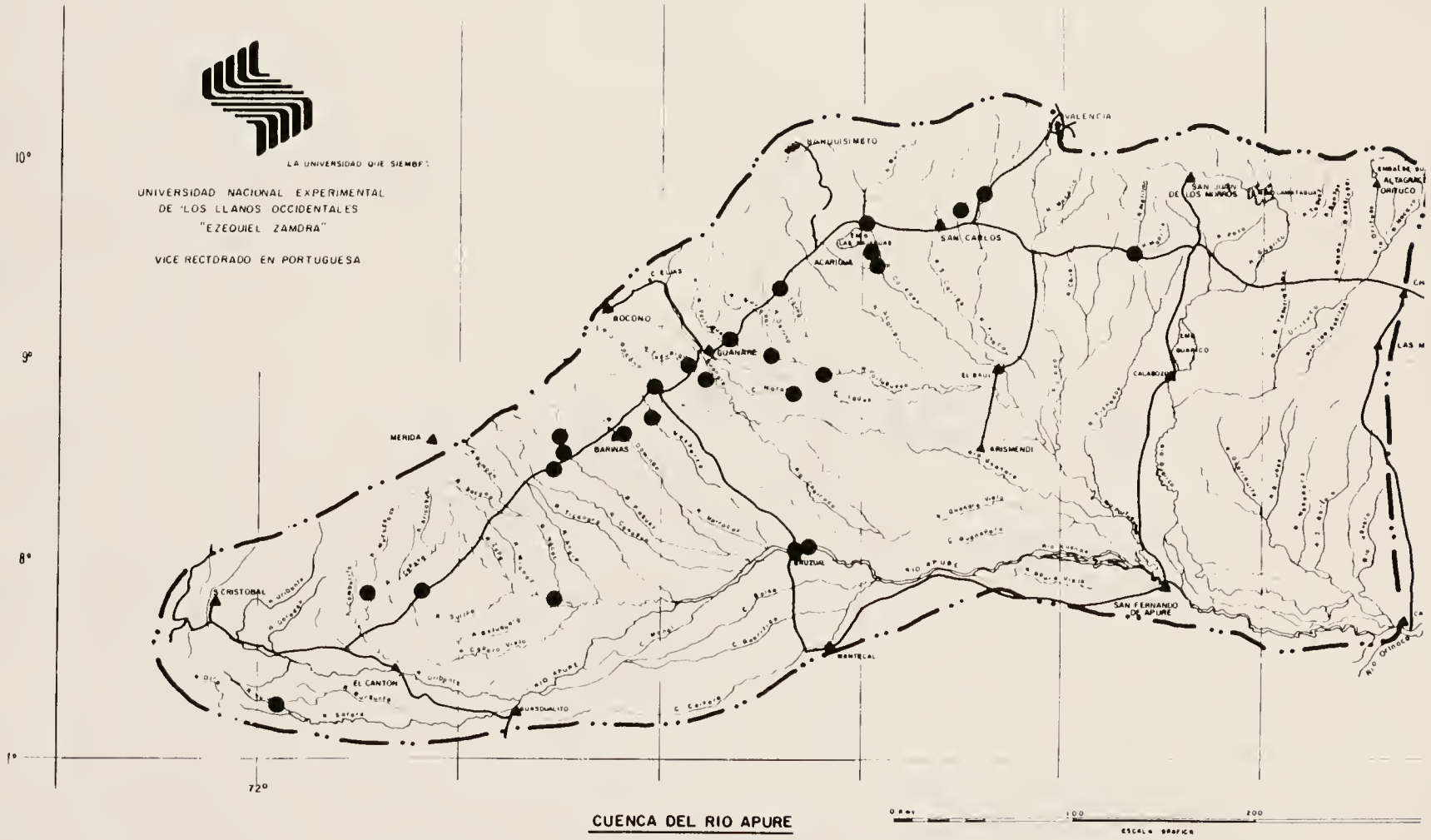
Number of specimens examined. 109 from 35 collections.

Food. OMNIVORE. It is probably mostly herbivorous.

Reproduction. Probable strategy: r2.

Importance. Ornamental.

Figure 18. Apure drainage distribution of *Leporinus striatus*.



CUENCA DEL RIO APURE

Leporinus yophorus Eigenmann 1922

Banded Leporinus - Mije Rayada

Fig. 19. Map fig. 20. Couplet 8a.

Specific synonymy.

Leporinus yophorus Eigenmann 1922:233 (type locality: Barrigón, Colombia, upper Río Meta)

?Leporinus affinis Pellegrin 1899:157 (Apure River, Venez.).

Types: Holotype: CAS 61680 (formerly IU 15025).

Comments. There are many names available for vertically banded Leporinus species. Most often they are called L. fasciatus, but L. latofasciatus and L. pearsoni are other possibilities for Venezuelan specimens. The Apure form agrees almost exactly with Eigenmann's (1922) original description of L. yophorus. Since both the habitat and drainage coincide, I feel reasonably confident about this identification. It is also possible that L. yophorus could prove to be a junior synonym of one of the older names such as Leporinus affinis Günther 1864, which was described from Para, Brazil, and was cited by Pellegrin (1899) from the Apure River. However, that species, which has nine vertical bars according to Géry (1977), is probably not present in the Orinoco Basin.

Etymology. Y = the letter "Y" refers to the Y-shaped bar on the side, OPHORUS = bearer of.

Description

Illustrations. Fig. 19; Eigenmann 1922:317 pl. 20, fig 4.

Diagnosis. The color pattern (fig. 19) is distinctive since this is the only Apure drainage Leporinus with bold vertical bars.

Size. It grows to about 180 mm SL

Figure 19. Leporinus yophorus.

Morphology. This is an elongate, slender Leporinus with a terminal mouth.

Counts. DR ii10; AR ii9; PR i15-i16; VR i9; LS 42-45; PDS 14-16; CPS 16; TS 12, 6 above, 5 below lateral line.

Measurements. Eigenmann (1922) gave the following measurements for the type: Head 5.0 in SL, depth 4.66, eye 2 in snout, 4.5 in the head, 2.0 in the interorbital; isthmus 3.5 in head; depth of caudal peduncle 2.4 in head. Apure specimens: GBD 23% (adults) to 29% (juveniles) SL; Eye 18% (adults) to 29% (juveniles) HL.

Pigmentation. The body is yellowish with seven wide vertical bars. The second bar is divided at the level of the lateral line to form a "Y" that extends dorsally.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 20. It is known only from four localities, three from within or near the Apure River itself, and one from the Tucupido River in the piedmont.

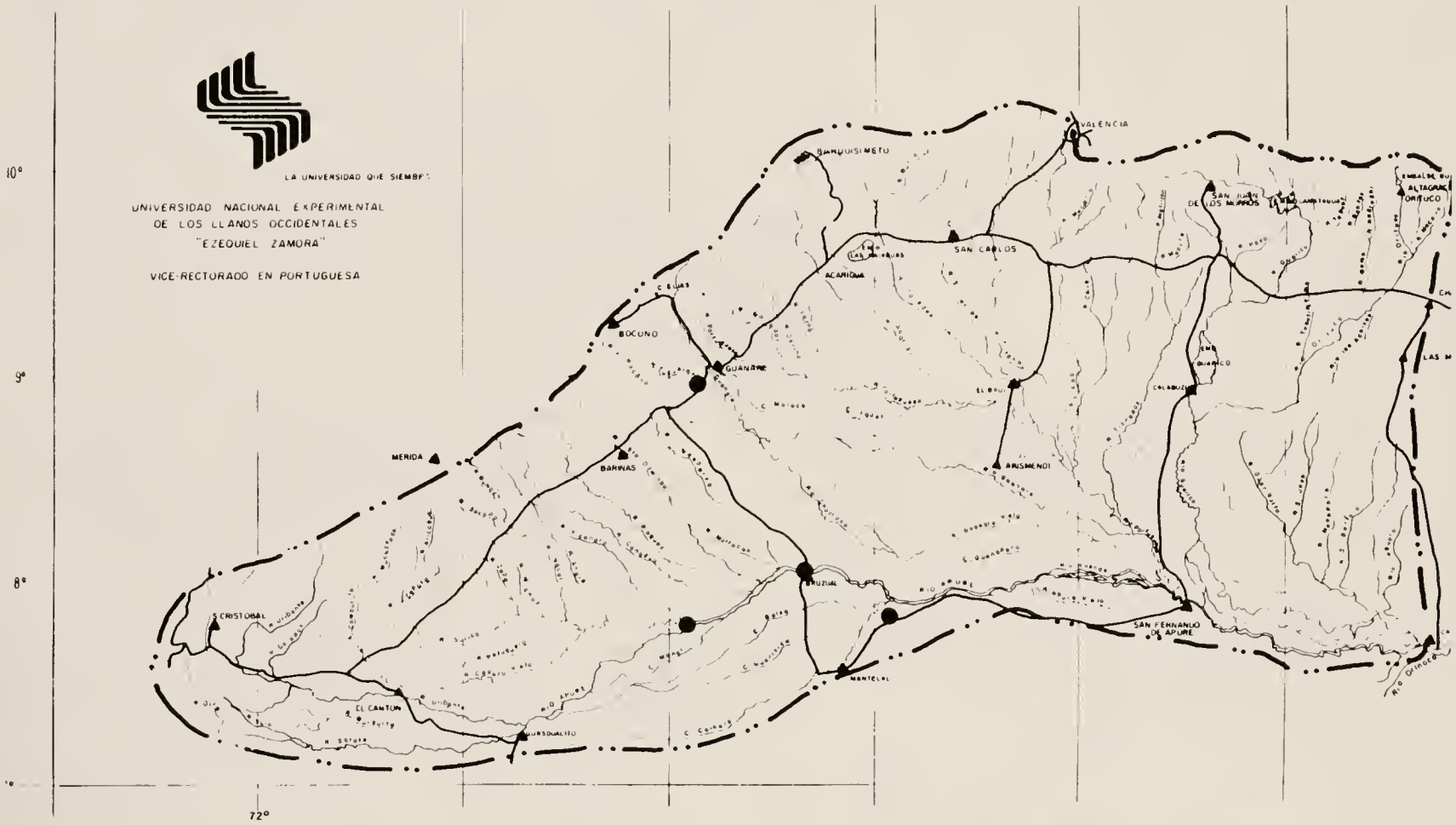
Habitat. There are insufficient numbers of collections to permit a thorough characterization of this species' habitat. The one adult captured was collected from a site in the Andean piedmont in a rapidly flowing, rocky river. The juvenile specimens were taken from near shore in muddy-bottomed side pools of the Apure River near Bruzual, amidst aquatic vegetation and submerged grasses. Thus, it seems that llaneran whitewater rivers are this species habitat.

Abundance. UNCOMMON, but it is probably difficult to capture.

Number of specimens examined. 84 from 11 collections.

Food. OMNIVORE. It is probably mostly herbivorous.

Figure 20. Apure drainage distribution of *Leporinus yophorus*.



CUENCA DEL RIO APURE

Reproduction. Probable strategy: r2.

Importance. Ornamental.

Pseudanos gracilis (Kner) 1859

Banded Headstander - Cabezibajo Rayada

Fig. 21. Map fig. 22. Couplet 4b.

Generic synonymy

Pseudanos Winterbottom 1980:24 (type species: Schizodon trimaculatus Kner 1859:161, by original designation).

Specific synonymy

Schizodon gracilis Kner 1859:160 (type locality: Rio Guaporé, Brazil).

Anostomus gracilis Myers 1950:184; Knöppel 1972:268 (diet); Mago L. 1970:75.

Pseudanos gracilis Winterbottom 1980:24 (redescription).

Types. Holotype: NMW 57-119.

Description

Illustrations. Fig. 21; Winterbottom 1980:83 fig. 20.

Diagnosis. The minute, superior mouth distinguishes this species from all Leporinus species. The pigmentation pattern (fig. 21) is also characteristic, and useful to distinguish it from P. gracilis, and Anostomus ternetzi.

Size. It grows to 160 mm SL, but most individuals are smaller.

Morphology. The body is fusiform but somewhat compressed.

Counts. DR iii10; AR iii8; PR i13-i16; VR i8; LS 43-47; PDS 11-15; CPS 16; TS 10, teeth 4-4 in both jaws (each with 2 to 4 cusps, though these can wear down, and become less conspicuous).

Measurements. GBD 18.3-25.4% SL

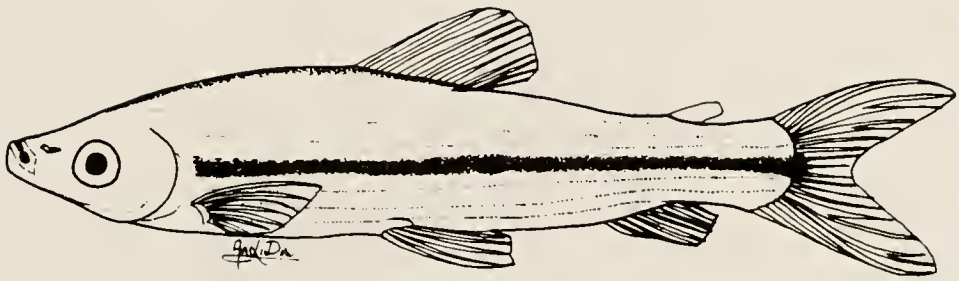
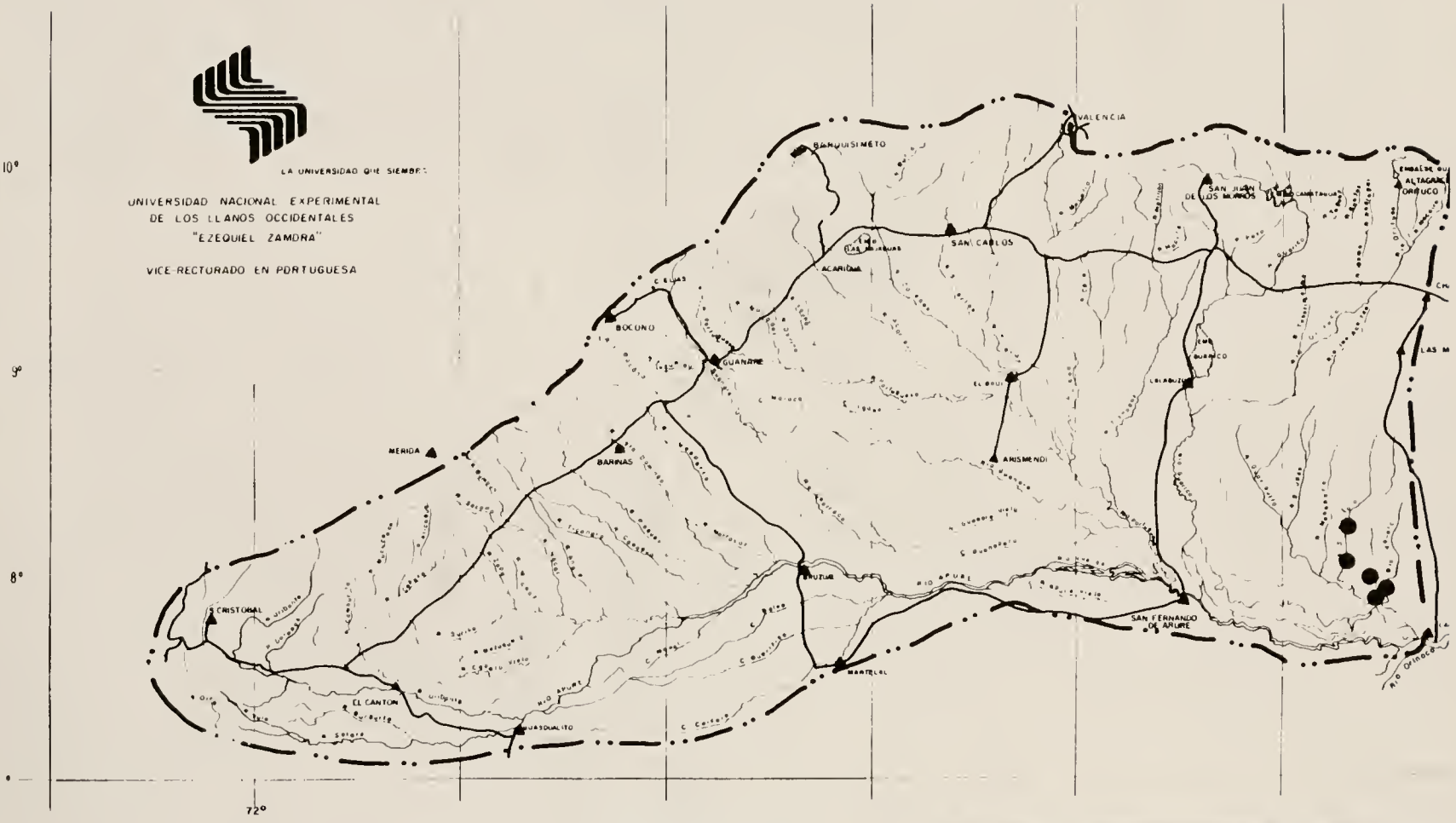


Figure 21. Pseudanos gracilis.

Figure 22. Apure drainage distribution of *Pseudanos gracilis*.



CUENCA DEL RIO APURE

Pigmentation. The pigmentation pattern varies in preserved material, but the dorsum never has cross bars. The body has up to 11 thin horizontal stripes formed by rows of dots (one per scale). A median predorsal stripe is also present. The midlateral sides are marked with a dark stripe or with series of up to four large rounded spots.

Etymology. PSEUD = false, ANOS = the first four letters of *Anostomus*, a very similar genus; GRACILIS = slender.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 22. It has been found only in the Aguaro River system. Interestingly, the distribution of this species seems to complement that of *P. irinae*, which is absent from the Aguaro systems but present in suitable blackwater habitats of northern Apure and Barinas.

Habitat. It is restricted to blackwater streams with abundant aquatic vegetation.

Abundance. RARE.

Number of specimens examined. 8 from 5 collections.

Food. OMNIVORE: It feeds on plant remains, fungi, algae, detritus, sand and terrestrial insects (Winterbottom 1980).

Reproduction. Probable strategy: rl.

Importance. Ornamental.

Pseudanos irinae Winterbottom 1980

Three spotted Headstander - Cabezibajo de Tres Puntos

Fig. 23. Map fig. 24. Couplet 3a.

Specific synonymy

Pseudanos irinae Winterbottom 1980:27 (type locality: Orinoco River system, Caño de Quiribana where it empties into the Orinoco).

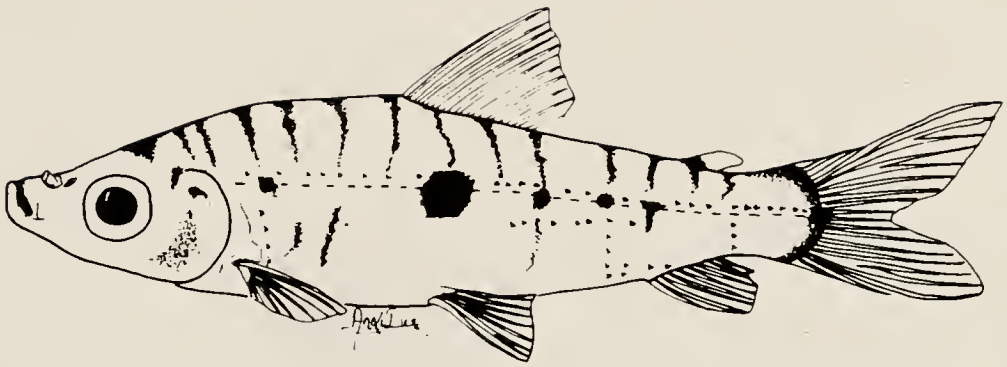


Figure 23. Pseudanos irinae.

Anostomus trimaculatus (non Kner 1859) Eigenmann 1912:295 (Essequibo River; Myers 1950:184 (upper Orinoco); Ramírez 1957:157 (Venez.); Mago L. 1970:75 (Venez.).

Types. Holotype: CAS 58809. Paratypes: deposited at AMNH, BMNH, CAS, FMNH (3) (Winterbottom 1980), catalog numbers not given.

Etymology. IRINAE = named for the wife of Dr. R. Winterbottom, Irina.

Description

Illustrations. Fig. 23; Axelrod et al. 1971:F-41.00 (identified as Anostomus trimaculatus); Winterbottom 1980:83, fig. 21.

Diagnosis. The pigmentation pattern is distinctive (fig. 23).

Size. It grows to about 100 mm SL.

Morphology. The body is fusiform and somewhat compressed.

Counts. DR 13-14; AR iii7-iii8; PR i13-i16; VR i7-i8; LS 41-45; CPS 16.

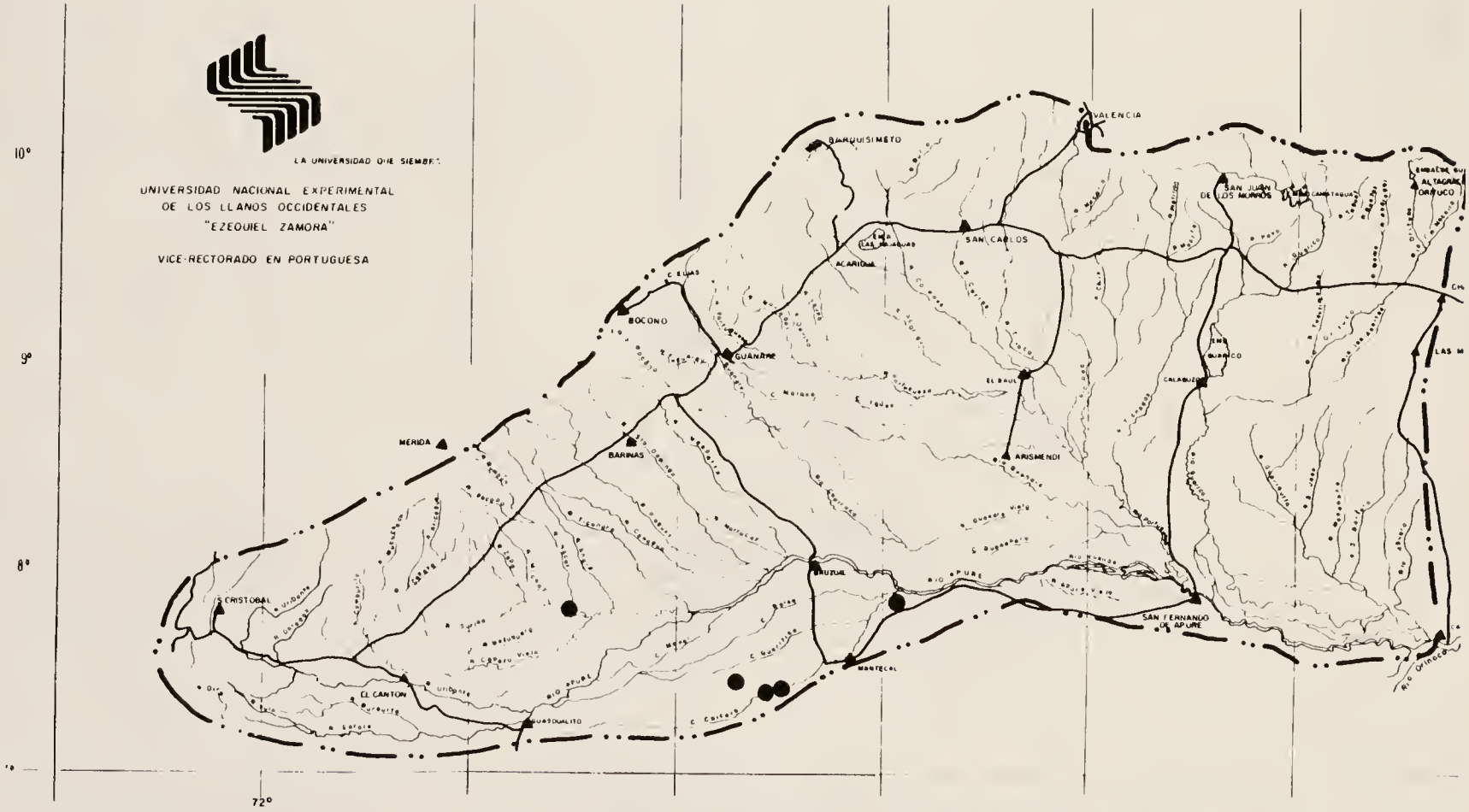
Measurements. GBD 23-29% SL.

Pigmentation. This fish is yellow-brown, paler below, with the dorsum crossed with irregular, thin vertical bars, and two to four dark spots or blotches on the sides. The first of these spots covers scales three to five of the lateral-line series and is situated partly beneath the lateral line), the other spots cover scales 16-19, 29-30, and 41-46. The first and third spots are often faint and may be absent. The area around each spot is lighter.

Distribution and Natural History

Range. It occurs in the Orinoco and Essequibo basins, of Colombia, Venezuela and Guyana.

Figure 24. Apure drainage distribution of *Pseudanos irinae*.



CUENCA DEL RIO APURE

Apure distribution. Map: fig. 24. It is so far known only from the Suripá River in Barinas, and the Guaritico system of northern Apure state.

Habitat. It is restricted to black or clearwater streams in the savannas of the low llanos. and is usually found in aquatic vegetation.

Abundance. UNCOMMON.

Number of specimens examined. 17 from 6 collections.

Food. OMNIVORE. The diet of this species is probably similar to that of the similar, preceding species which feeds on plant remains, fungi, algae, detritus, and insects.

Reproduction. Probable strategy: rl.

Importance. Ornamental.

Schizodon isognathus Kner 1859

Boquimí, Coti, Pijotero - Schizodon

Fig. 25. Map: fig. 26. Couplet 5a.

Generic synonymy

Schizodon Agassiz 1829:66 (type species: Curimatus fasciatus Agassiz, by monotypy).

Specific synonymy

Schizodon isognathus Kner 1859:163 pl. 6 (not pl. 7 as stated in the text; type locality: Rio Cujaba).

Anostomus isognathus Peters 1877:472 (San Fernando de Apure, Venez.).

Comments. Recent investigations by biologist María Esther Antonio of the Universidad Central de Caracas indicate that this species is distinct from the Amazonian S. isognathus, and perhaps new.

Etymology. SCHIZ = divided, ODON = teeth; ISO = even, equal, GNATHUS = jaws.

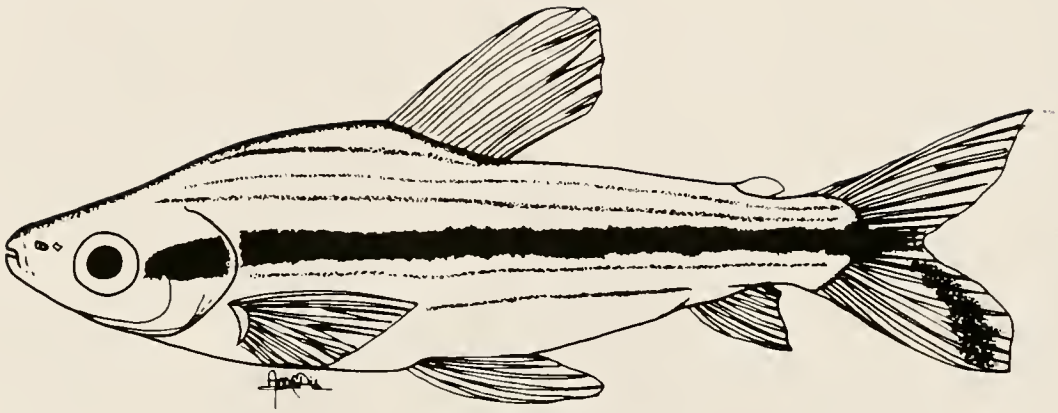


Figure 25. Schizodon isognathus.

Description

Illustrations. Fig. 25; Román 1983:98 (name misspelled as "Shizodon sp.").

Diagnosis. This species has a distinctive pigmentation pattern (fig. 25). It is further characterized by its bi- to pentacuspid incisiform teeth, and a relatively short anal fin, with only seven branched rays. Extremely similar species of Laemolyta are known from the neighboring Capanaparo River to the south of the Apure drainage, but they all have a superior mouth as adults, as opposed to the terminal mouth of Schizodon isognathus that have attained a size of over 40 mm SL (smaller juveniles have superior mouths and are not readily identified).

Size. It grows to at least 300 mm SL.

Morphology. This species is slender and elongate, the greatest body depth is slightly less than the head length. The mouth position changes with size! Specimens examined of 20, 35, 41, 51 and 62 mm SL have superior mouth. At 74 and 93 mm the mouth was just barely superior, and at 120 mm it was terminal.

Counts. DR ii10; AR ii7-iii7; PR i15-i16; VR i8; LS 43-45; PDS 10-11; CPS 16; TS 10-11, 5 above, 4-5 below lateral line. Teeth 4-4 in both jaws.

Measurements. GBD 24-27% SL.

Pigmentation. A wide black stripe extends along the midaxis of the body from the head to the base of tail, and is accented by a pale streak above and below. Some specimens have 3-4 dark blotches extending vertically out from the lateral stripe. The first of these (when present) is over the pectoral fins, the second under the dorsal fin,

the third between the dorsal and adipose fins, and the fourth under the adipose fin. Juveniles less than 35 mm SL have no dark lateral band, but rather have faint vertical bars.

Distribution and Natural History

Range. It reportedly occurs in both the Amazon and Orinoco basins, but as noted above, more than one species may be involved.

Apure distribution. Map: fig. 26. It is widespread in the piedmont and llanos.

Habitat. It occurs in most water types, both lentic and lotic.

Abundance. COMMON.

Number of specimens examined. 296 from 92 collections.

Food. HERBIVORE. Its diet consists mainly of aquatic vegetation, but specimens from ponds in cattle pastures were found to have ingested manure.

Reproduction. Probable strategy: r2.

Migrations. It is known to accompany *Prochilodus mariae* on their annual migrations. Large schools of fishes known locally as the ribazón, move upstream at the onset of the dry season in November or December. Fish remain in the highlands during the dry season, feeding on algal growth and aquatic plants that are stimulated by the additional light they receive at this time due to increased water clarity (lower dry-season flow reduces the suspended sediment load dramatically). With the return of the rains, fishes move downstream again. Many spawn at this time in midriver.

Importance. It is of only minor commercial importance because of the numerous intermuscular bones. However, in recent years many species that were once discarded as inedible have acquired value because of failing fish stocks and higher prices for favorite food fishes.

Figure 26. Apure drainage distribution of *Schizodon isognathus*.

CUENCA DEL RIO APURE

Characidae

As mentioned earlier, because of the great diversity in their form, it is difficult to morphologically characterize the Characidae succinctly. Such different fishes as the slender, well-toothed pike characins, Acestrorhynchus; giant 40 kg herbivorous pacus or cachamas, Colossoma; a host of small tetras such as the various species of Astyanax and Hemigrammus; the infamous, mostly carnivorous, piranhas, Serrasalmus and Pygocentrus; tusked, transparent scale-eating glass characins like Roeboides; salmon-like "dorados," Salminus, from the Andes; plate-shaped palometas, Mylossoma; and trout-like Brycon all belong to this extremely heterogeneous lineage of fishes. As taxonomic work at family and subfamily levels progresses, some of the more widely divergent groups may be elevated to family status or reassigned to other families.

The Characidae is the dominant family in the Apure River drainage ichthyofauna in terms of species, absolute numbers and biomass. About 90 species were identified in the 7,642 lots (containing 149,347 individuals) of characids examined during this study. In our study of the Apure module fishes (Taphorn and Lilyestrom 1984), characids were always among the species of maximum abundance and biomass.

Knowledge of the natural history of characids is still in its infancy. Most species are feeding generalists and can quickly switch diets to adapt to changing food availability in the drastically different wet and dry seasons typical of the llanos. Reproductively, all species are r1 or r2, and most are egg scatterers that provide no parental care. Larger species tend to spawn annually with the onset of the rains. Smaller species usually produce smaller quantities of eggs, but spawn all during the wet season, and even into the dry if conditions remain suitable.

Key to the Species of Characidae of the Apure River Drainage

This key is intended only as an aid to identification of the genera and species present in the Apure River drainage, and does not reflect phylogenetic relationships. When appropriate, data from previous keys have been used, including those by Eigenmann (1912, 1917), Schultz (1944b), Géry (1972), Menézes (1976), and Machado A. (1985).

1a. Dorsal-fin origin over (fig. 27a) or behind (fig. 27b) anal-fin origin 2

1b. Dorsal fin origin in front of vertical through anal-fin origin (fig. 27c)... ...12

2a. (1a) Adipose fin absent; males with elongate filament on opercle and with lower caudal lobe elongate and sword shaped... *Corynopoma riisei* (fig. 105)

2b. Adipose fin present; males lacking structures in 2a... ...3
(Note: The adipose fin may sometimes be lost through injury, so check for stub of that fin, or examine several individuals.)

3a. (2b) Anal rays more than 55; dorsal-fin origin far behind anal-fin origin (more than a distance equal to dorsal-fin length behind anal-fin origin)... *Xenagoniates bondi* (fig. 230)

3b. Anal rays 25 to 55; dorsal-fin origin over or just slightly behind anal origin (never more than a distance equal to dorsal-fin length behind anal-fin origin)... ...4

4a. (3b) Maxilla longer than vertical eye diameter (fig. 28) ...5

4b. Maxilla shorter or about equal to vertical eye diameter... ...9

5a. (4a) Lateral line incomplete or interrupted; prepectoral region slightly to strongly keeled... ...6

5b. Lateral line complete; prepectoral area rounded or flat... ...7

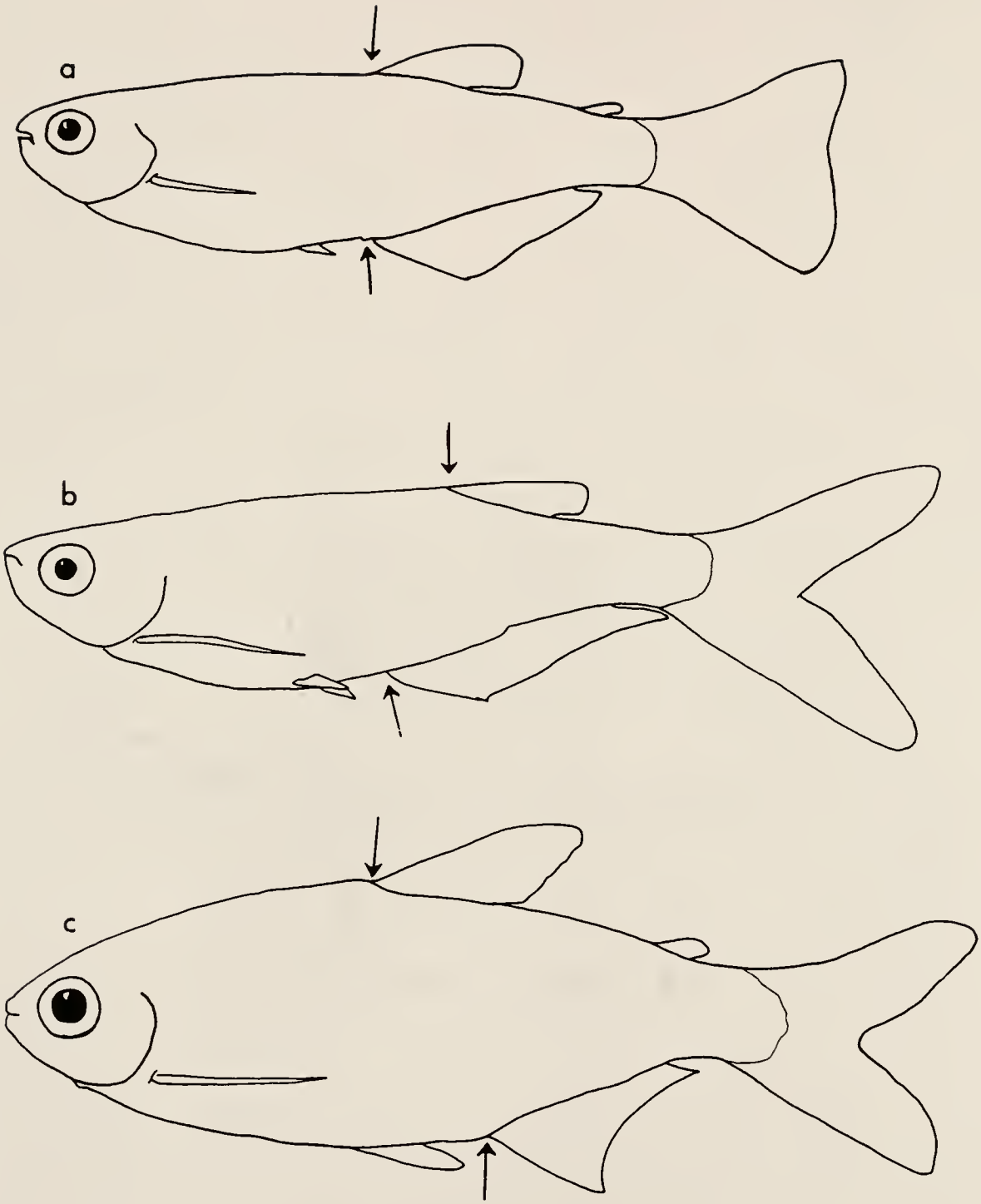


Figure 27. Relative position of dorsal and anal fin in characids.
a. dorsal-fin origin over anal-fin origin.
b. dorsal-fin origin behind anal-fin origin.
c. dorsal-fin origin in front of anal-fin origin.

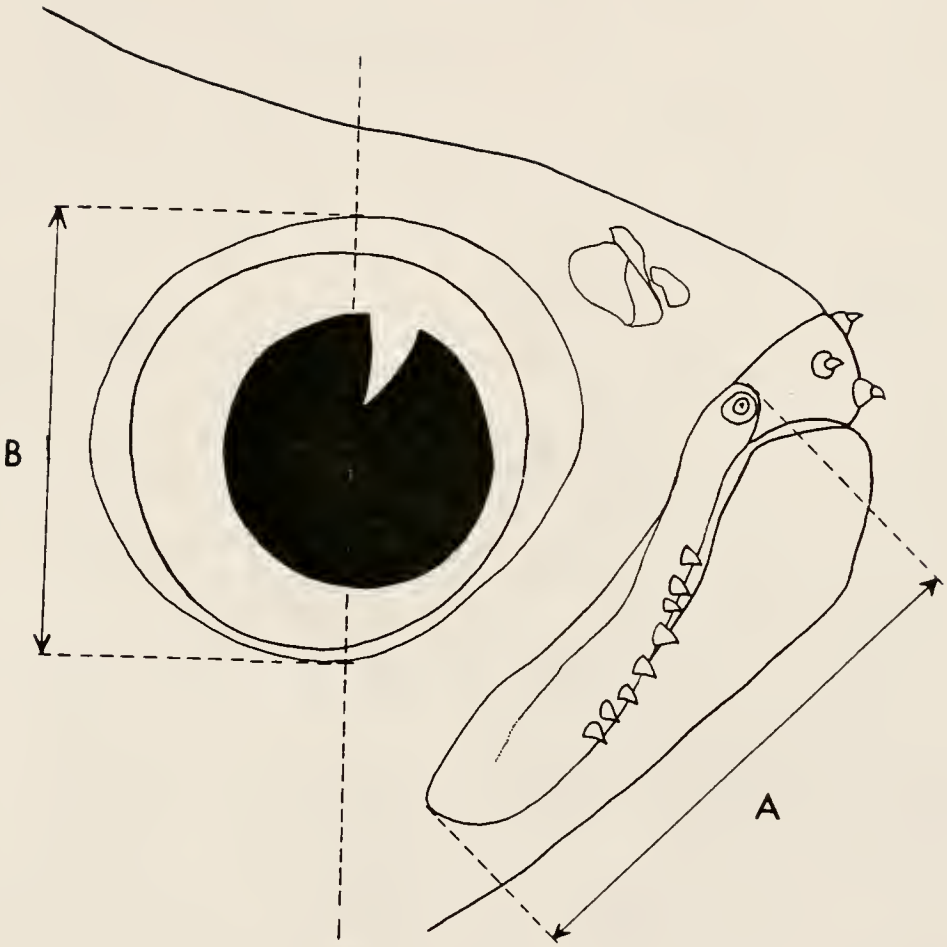


Figure 28. Relative lengths of maxilla and vertical eye diameter.
Arrow (A) indicates length of maxilla.
Arrow (B) indicates length of vertical eye diameter.

6a. (5a) Fewer than 40 anal-fin rays; lateral scales 33-37; base of anal fin scaled only anteriorly, with 1/2 to 1 scale; dorsal midline with a black narrow stripe from occiput through dorsal-fin base... Gnathocharax steindachneri (fig. 123)

6b. Anal-fin rays 40 or more; lateral scales 41-45; entire length of anal-fin base sheathed with 2 or more rows of scales; dorsal midline lacking stripe... Paragoniates alburnus (fig. 188)

7a. (5b) Upper jaw with "tusks" or out-turned conical teeth protruding through skin of snout (figs. 29a & b); premaxilla with conical teeth but these not elongated to form canines; maxilla not extending back beyond middle of eye; spiny projection of cleithrum below pectoral-fin base not very elongate, triangular or rounded in shape and not reaching posterior edge of pectoral-fin base (figs. 29a & b)... ...8

7b. Upper jaw lacking "tusks" (fig. 30); premaxilla with canines; maxilla extending back to middle of eye or beyond; spiny projection of cleithrum (below pectoral-fin base) elongate, reaching posterior edge of pectoral-fin base (or nearly so) (fig. 30)... Charax gibbosus (fig. 98)

8a. (7a) Upper jaw extending well beyond lower; lateral scales 67-81; projection below pectoral notch more weakly developed, and less strongly triangular with tip rounded; tusks stout and prominent (fig. 29a)... Roeboides affinis (fig. 204)

8b. Upper jaw about even with lower; lateral scales 53-65; projection below pectoral notch in cleithrum strongly triangular; tusks moderately to weakly developed (more weakly developed in smaller individuals) (fig. 29b)... Roeboides dayi (fig. 206)

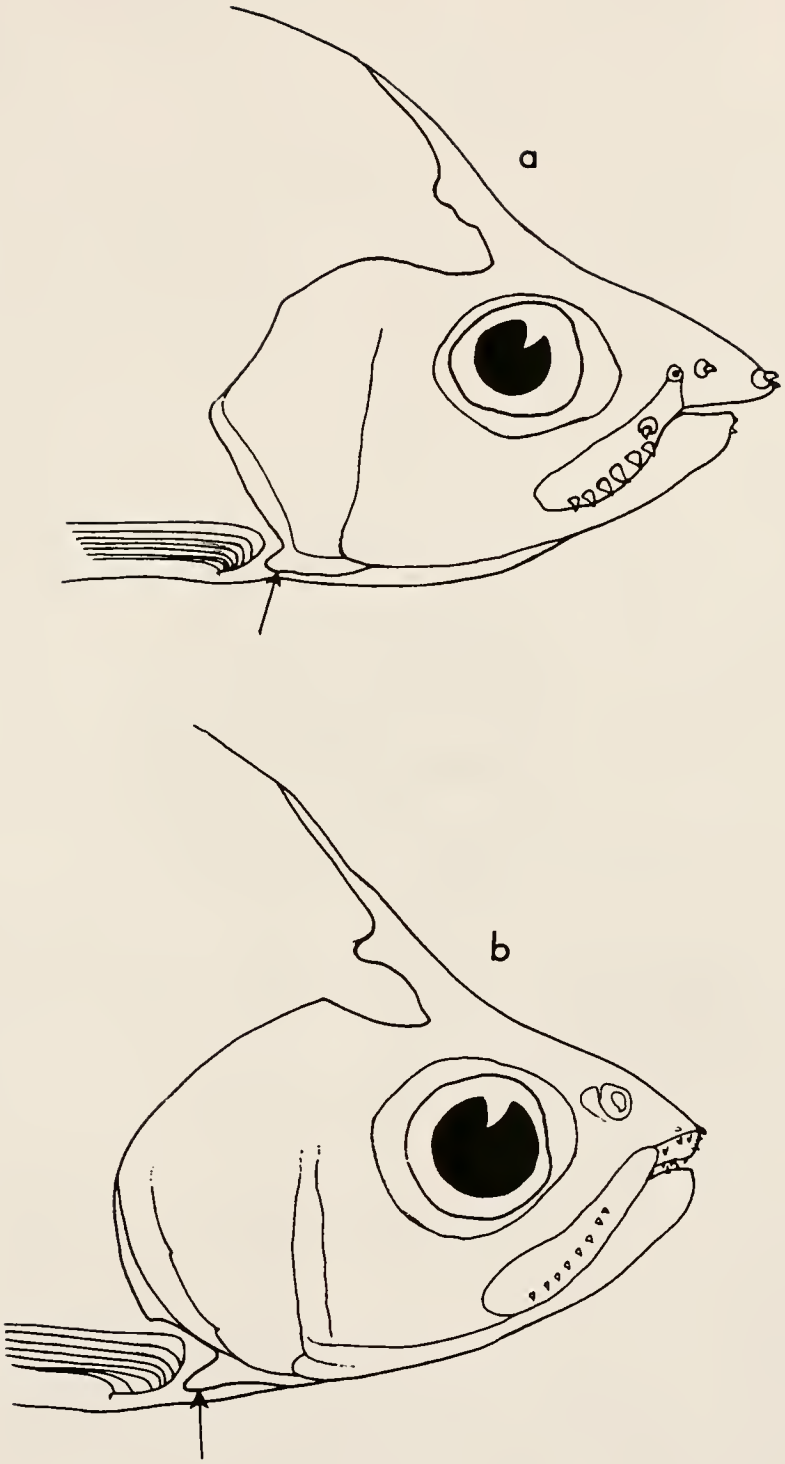


Figure 29. "Tusks" of Roeboides spp.
a. Roeboides affinis.
b. Roeboides dayi.

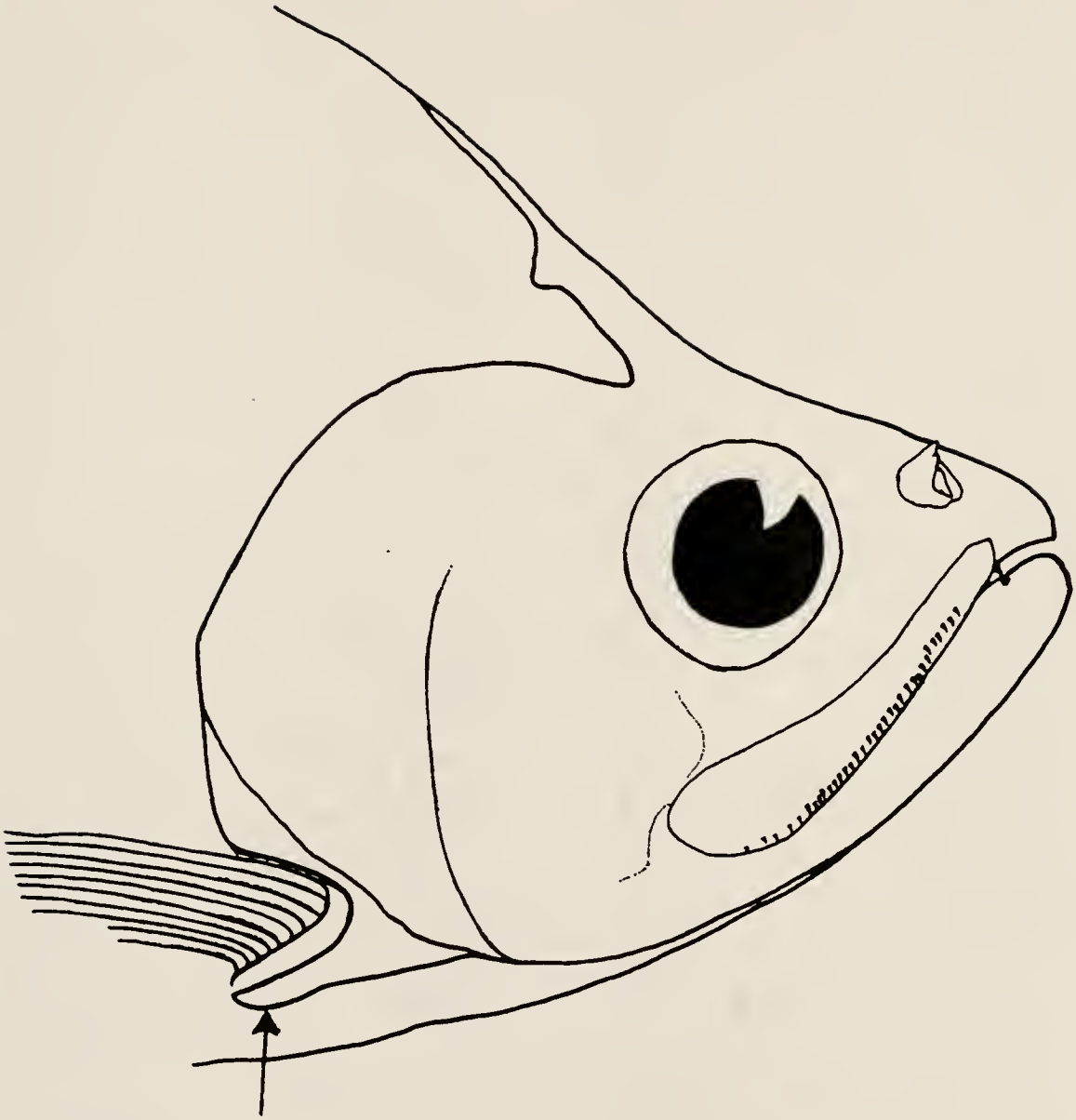


Figure 30. Head and anterior body of Charax gibbosus.
Note lack of "tusks" on upper jaw and long spinous projection of cleithrum.

9a. (4b) Maxillary teeth present and obvious, conical in shape, and present along entire length of bone; premaxillary and dentary teeth conical... Heterocharax macrolepis (fig. 153)

9b. Maxillary teeth absent or not obvious, if present, conical in shape and present only in upper corner of bone adjacent to premaxilla; premaxillary and dentary teeth tri- or multicuspid.....10

10a. (9b) Body depth less than 2.5 in SL; scales ctenoid, at least in prepelvic area; anal rays 39 to 43...

Ctenobrycon spilurus (fig. 113)

(in part, see couplet 40a)

10b. Body depth more than 3 in SL; scales cycloid; anal-fin rays 28 to 35... ...11

11a. (10b) Lateral line complete; lower caudal rays in males modified to form a spur (fig. 31); dorsal-fin origin behind anal-fin origin; lateral scales 38-43...Gephyrocharax valenciae (fig. 121)

11b. Lateral line incomplete, with only 6-8 pored scales (not passing tip of depressed pectoral fin); lower caudal rays normal; dorsal-fin origin over anal origin; lateral scales 31-35...

Classification uncertain (fig. 232)

(Note: This fish might simply be another species of Hemigrammus, but the dorsal fin is positioned much farther back than in most members of that genus; furthermore, this fish has a rather flat predorsal profile, similar to that observed in Gephyrocharax.)

12a. (1b) Snout with outward projecting "tusks" or mammila (tooth-like projections used to scrape scales from other fishes)... ...13

12b. Snout without tusks (teeth all inside mouth)... ...14

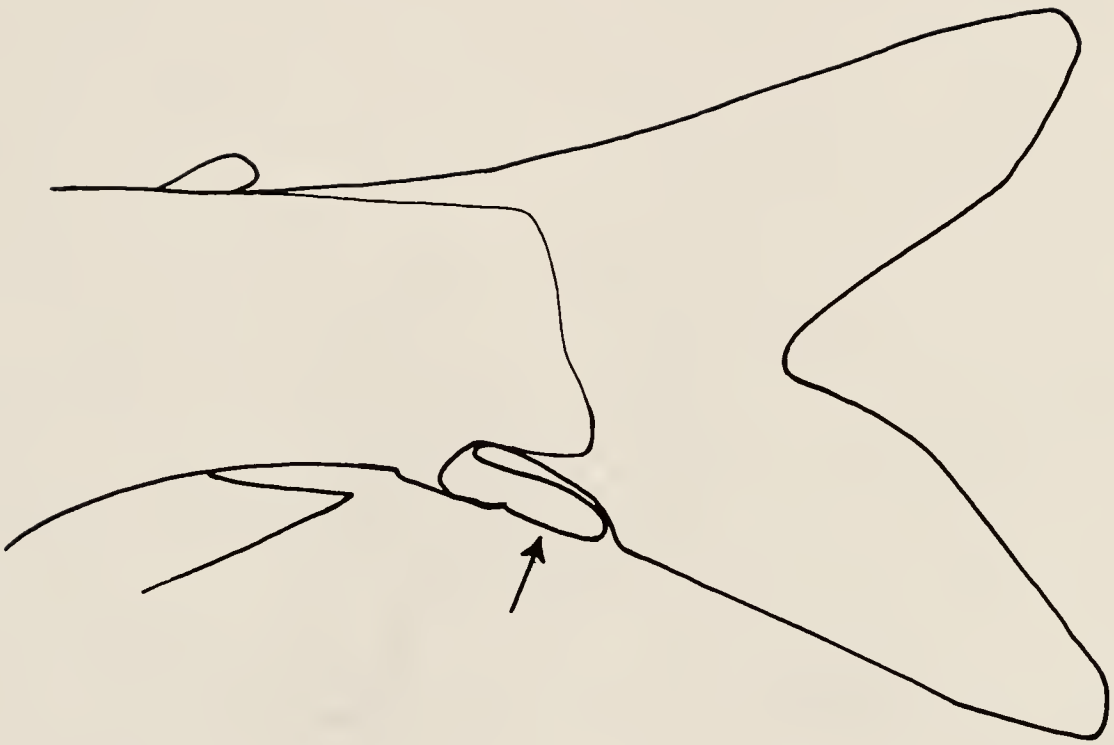


Figure 31. Modified caudal rays (spur) of male Gephyrocharax valenciae.

13a. (12a) Color pattern unique: two very large, round black spots, one of which covers most of caudal peduncle, the other situated on side just anterior to dorsal fin (sometimes with a faint line connecting these spots); lateral line complete...

Exodon paradoxus (fig. 32)

(Note: This species has not yet been collected in the Apure drainage but occurs in the Capanaparo, Cinaruco and Meta rivers.)

13b. Color pattern not as in 13a; body without large spots, a narrow midlateral line present, and an arrowhead-shaped, black spot present at base of tail; lateral line incomplete...

Serrabrycon magoi (fig. 210)

14a. (12b) Preventral abdominal midline with a series of hard, sharp-pointed, bony serrae or scutes (sometimes only the tips emerge from skin); body usually deep and disk-shaped... ...15

14b. Preventral abdominal midline lacking hard bony scutes and not serrate, though the abdominal scales may sometimes form a (much softer) keel; body shape variable... ...32

15a. (14a) Adipose-fin base length greater than or equal to distance from posterior edge of dorsal-fin base to origin of adipose fin (fig. 33a)... Genus *Metynnis* (three spp.)... ...16

15b. Adipose-fin base length less than distance from posterior edge of dorsal-fin base to origin of adipose fin (fig. 33b) ...18

16a. (15a) Gill rakers very long and fine, densely packed, more than 50 gill rakers on first (outer) arch; some living specimens with red humeral spot; dorsal fin usually not spotted...

Metynnis luna (fig. 169)

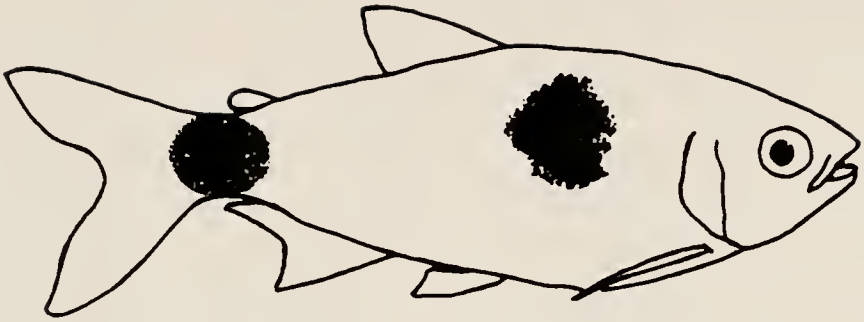


Figure 32. Pigmentation pattern in Exodon paradoxus

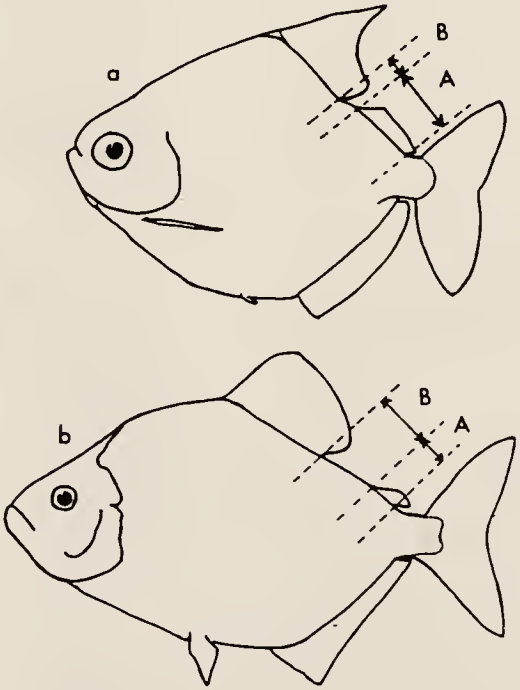


Figure 33. Relative adipose fin base lengths in Metynnis spp.
a. adipose fin base length (A) greater than distance from posterior edge of dorsal-fin base to origin of adipose fin (B).
b. adipose fin base length (A) less than distance from posterior edge of dorsal-fin base to origin of adipose fin (B).

16b. Gill rakers long, but not so fine and less closely packed, fewer than 40 gill rakers on first arch; humeral spot in living specimens usually not red; dorsal fin with or without spots... ...17

17a. (16b) Supraoccipital process relatively short, usually more than 2.6 in distance from base of occiput to dorsal-fin origin; adipose fin not extremely long and low, the dorsal-adipose distance usually less than 1.5 times in its base; gill rakers 17-23 on first arch; dorsal fin usually marked with small spots... *Metynnis argenteus* (fig. 165)

17b. Supraoccipital process very long, usually less than 2.4 in distance from base of occiput to dorsal-fin origin; adipose fin extremely long and low, dorsal-adipose distance usually more than 1.5 in its base; about 35 gill rakers on first arch; dorsal spotted or not... *Metynnis hypsauchen* (fig. 167)

18a. (15b) Dorsal rays 25 or more...*Myleus rubripinnis* (fig. 183) (Note: A juvenile, identified as *M. pacu*, from the Río Aguaro, has fin-ray counts of DR iii20 and AR iii31, and the incisors of the first premaxillary row closely appressed to the second row of molariform teeth. It is not in this key, but is described in the species accounts, it may be confused with a juvenile *Mylossoma*, and key out in couplet 31).

18b. Dorsal rays 24 or fewer... ...19

19a. (18b) Upper jaw (premaxilla) with one row of teeth... ...20

19b. Upper jaw (premaxilla) with two rows of teeth... ...29

20a. (19a) Teeth in lower jaw robust, round-based, nearly conical and directed somewhat outward, set well apart, not touching; lower jaw extremely evertible... *Catoprion mento* (fig. 96)

20b. Teeth in lower jaw flattened and compressed, usually tri- or pentacuspid, and set very close together, usually touching; lower jaw not greatly evertible... ...21

21a. (20a) Teeth more or less symmetrically pentacuspid, the central cusp a little larger than the other four (fig. 34a), as in most characids, teeth not jammed together to form a single cutting edge; premaxilla and dentary with pentacuspid teeth; dorsal-fin rays 18-20; adipose fin long, its length greater than eye diameter... *Pygopristis denticulatus* (fig. 202)

21b. Teeth asymmetrically tri- to pentacuspid (fig. 34b), jammed together to form a single saw-toothed cutting edge; teeth of premaxilla and dentary at most tricuspid, with central cusp strongest; dorsal rays 15-17; adipose fin usually less than eye diameter...22 (Note: The section of the key which deals with the piranhas (couplets 22-28) may not work for those individuals that have not yet attained adult pigmentation. Juvenile pigmentation patterns persist in most species up to about 30 mm SL. A separate key to the juveniles is not presently possible, see Machado A. (1985) for the identification of some juveniles.)

22a. (21b) Anal rays 29 or fewer; head and jaws wide and robust; snout short and blunt; body stocky; dorsal profile from snout to behind eyes convex; roof of mouth never with teeth; normal color pattern with bright red belly and a dark black humeral spot behind opercle (but old or reproductive individuals are often all black, and juveniles under 30 mm SL are plain with a spot on caudal peduncle as in most piranhas); head wider, bony interorbital width less than three times in head length...*Pygocentrus caribe* (fig. 200)

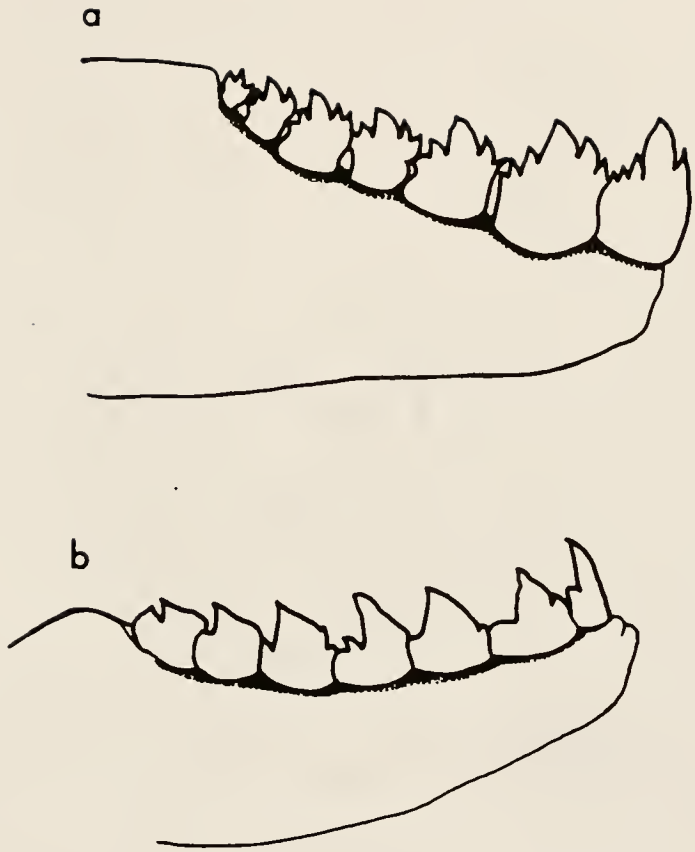


Figure 34. Piranha teeth.
a. Symmetrical pentacuspid teeth found in *Pygopristis denticulatus*.
b. Asymmetrically tri- or pentacuspid teeth found in most other piranhas.

22b. Anal rays 30 or more; head and jaws usually more slender and longer; snout longer; body less stocky, somewhat more compressed than in couplet 22a; dorsal profile from snout to behind eyes concave; roof of mouth with teeth, except in old individuals that may wear them out; color variable, belly red only in breeding season, if at all, pigmentation pattern (in preservative) usually including numerous spots on sides; head narrower, bony interorbital width usually more than three times in head length... ...23

23a. (22b) Last (sixth) tooth on premaxilla low and long, its base much wider than that of the tooth preceding it; teeth on roof of mouth (on ectopterygoid) triangular, bi- or tricuspids, with central cusp largest, and lateral cusps small, often hidden near base of tooth beneath skin, these teeth flattened to form sharp cutting edges, usually seven or more present on each side... ...24

23b. Last (sixth) tooth on premaxilla with base about as wide as that preceding it; teeth on roof of mouth (ectopterygoid) unicuspid, squared distally with rounded base, more conical than flattened, usually fewer than five present on either side... ...28

24a. (23a) Caudal fin with black outer border (fig. 35c), sometimes mostly black (fig. 35a & b)... ...25

24b. Caudal fin with a distinct, black, median or basal, vertical band; the outer border of fin clear or hyaline (fig. 36)... ...27

25a. (24a) Caudal fin not usually black to tips, edges clear (fig. 35b); body relatively elongate, its maximum depth more than two times in SL (without lower jaw); a silvery fish with spots on upper sides usually running together to form vertical wavy lines... Serrasalmus elongatus (fig. 216)

(in part, this species also keys out in couplet 27a)

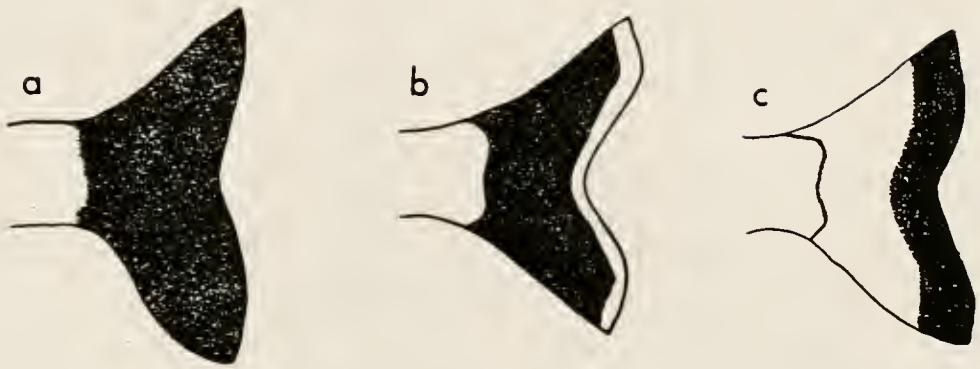


Figure 34. Caudal pigment patterns in piranhas.
a. caudal fin all or mostly black.
b. caudal fin mostly black with hyaline edge.
c. caudal fin with black outer edge.

Figure 36. Piranha caudal fin pigmentation showing median black band, (basal black band not shown).

25b. Caudal fin all black or with black outer border (fig. 35a & c); body deeper, its maximum depth less than two times in SL... ...26

26a. (25b) Body depth less than 1.7 times in SL (without lower jaw); dorsal rays 16-19, usually 17 or more; preventral scutes 17-20; head slender; body compressed; spots on sides frequently vertically elongate; width of lower jaws at commissure less than diameter of eye... Serrasalmus altuvei (fig. 212)

26b. Body depth 1.7-2.0 in SL except in largest adults (over 150 mm SL), where it is about 1.6, (however, S. altuvei seldom reaches 150 mm); dorsal-fin rays 15-17, usually 16 or fewer; preventral scutes 18- 24; head wide and massive; body thick; spots on sides rounded; lower jaw very robust in largest individuals, with the width at the commissure of the jaws is greater than the eye diameter... Serrasalmus rhombeus (fig. 220)

27a. (24a) Anal-fin rays 31 or fewer; body more elongate, its maximum depth always more than two times in SL (without lower jaw); head and jaws not very compressed, bony interorbital width less than 3.3 times in head length; spots on sides frequently united to form wavy vertical lines; body and opercle usually silvery in preservative.. Serrasalmus elongatus (fig. 216)
(in part, this species also keys out in couplet 25a)

27b. Anal-fin rays 32 or more; body less elongate, smaller specimens sometimes have a maximum body depth that fits more than two times in SL (without lower jaw), but body depth increases with size; head and jaws narrow and compressed, the least bony interorbital width more than 3.3 in head length; spots on sides rounded, seldom united to form vertical lines; body and opercle usually tan or yellowish in preservative... Serrasalmus irritans (fig. 218)

28a. (23b) Sides plain silvery with a few scattered irregular spots (more obvious in preservative); caudal peduncle often edged posteriorly with a faint, thin, black bar that extends along upper and lower caudal-fin rays, rest of fin clear, the border not edged in black; no humeral spot; a faint black line along base of anal fin (fig. 37)... *Pristobrycon striolatus* (fig. 198)

28b. Sides heavily spotted (more obvious in preservative); caudal peduncle plain or with a wide, diffuse, darker central area, caudal fin usually edged in black as in *S. rhombeus* (fig. 35c); a distinct dark humeral spot just behind opercle; no black line along anal base, although this fin often has a black outer border... *Serrasalmus medinae* (fig. 214)

29a. (19b) Anal fin with fewer than 30 rays, the fin scaled only on its base; no predorsal spine embedded in flesh immediately in front of dorsal-fin base; body heavyset; each side of lower jaw with six or more teeth; large species that reaches some 40 kg... ...30

29b. Anal fin with more than 35 rays, the fin scaled well beyond base; predorsal spine present, embedded in flesh immediately in front of dorsal-fin base (fig. 38); body disk shaped, very compressed; each side of lower jaw with only four teeth; moderate sized species that seldom reach over 1 kg...Genus *Mylossoma* (2 spp.)... ...31

30a. Lateral-line scales usually 67-76; scale rows above lateral line to dorsal-fin base 19-23; total gillrakers in first arch from 26 (in juveniles) to over 146 in larger individuals; adipose-fin with ossified rays in specimens over 55 mm SL; maxilla without teeth; opercle very wide (fig. 39a)...*Colossoma macropomum* (fig. 104)

Figure 37. Caudal fin pigmentation in Pristobrycon striolatus.

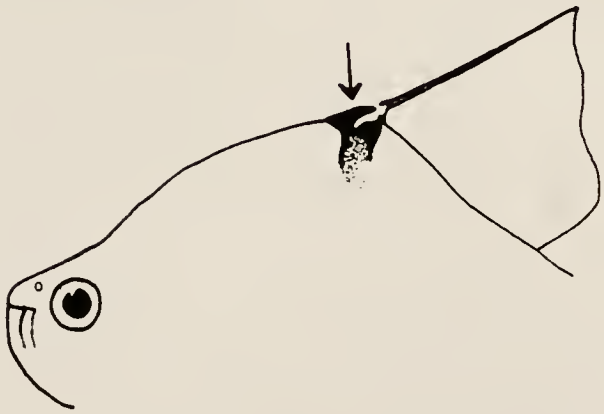


Figure 38. Predorsal spine found some serrasalmines.

30b. Lateral-line scales usually 78-90; scale rows above lateral line to dorsal-fin base 26-30; total gillrakers in first arch 26-36; adipose fin without ossified rays at any size; maxilla with 1-3 teeth in upper corner; opercle narrower (fig. 39b)...

Piaractus brachypomus (fig. 194)

31a. (29b) Serrae on midline of belly behind pelvic fins 18-22, the last one very close to first anal-fin ray; branched anal-fin rays about 37; base of adipose 2.66-3.66 in dorsal-fin base...

Mylossoma duriventris (fig. 186)

31b. Serrae on midline of belly behind pelvic fins 10-16, the last one not close to first anal-fin ray; branched anal-fin rays 28-34; base of adipose fin 3.75-4.25 in dorsal-fin base...

Mylossoma aureum (fig. 185)

32a. (14b) Anal-fin base short; anal-fin rays 16 or less... ...33

32b. Anal-fin base moderate to long; anal-fin rays 17-52... ...38

33a. (32a) Lateral line incomplete, pored scales not reaching level of dorsal-fin origin... ...34

33b. Lateral line complete... ...35

34a. (33a) Caudal fin with triangular black spot on median rays; anal-fin rays 15-16; no thin black line on mid-ventral part of caudal peduncle; maxilla with 5-7 tiny tricuspid teeth...

Parapristella georgiae (fig. 190)

34b. Caudal fin plain, without a spot; anal-fin rays 13-14; a thin black line along mid-ventral part of caudal peduncle; maxilla without teeth or with 1-2 wide teeth, each with 5-7 cusps...

Hemigrammus cf *analis* (fig. 129)

(in part, see also couplet 66a)

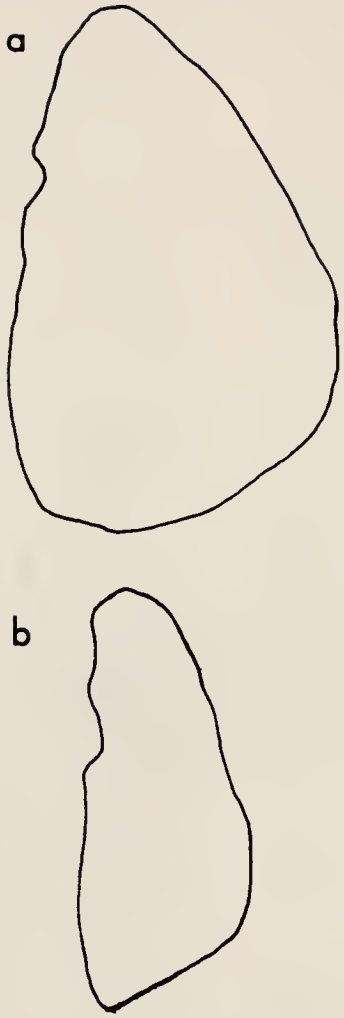


Figure 39. Opercular bone shape in:
a. Colossoma macropomum.
b. Piaractus brachypomus.

35a. (33b) Scales in the row above lateral line much larger than the pored scales of the lateral line (22 in series from opercle to base of tail versus 32 pored lateral-line scales); dorsal-fin rays 11-12; a large species reaching over 70 mm SL...

Chalceus macrolepidotus (no fig.)

(Note: This species is not yet reported from the Apure drainage).

35b. Scales along side of body all of about the same size, from 35-40 in number; dorsal-fin rays ten; smaller species seldom exceeding 70 mm SL, usually much smaller...Genus Creagrutus (three spp.)...36

36a. (35b) Dorsal fin pigmented, ranging from a dark central black blotch to mostly black throughout, with fin tip clear; scales in series from lateral line to dorsal fin origin six...

Creagrutus n. sp. (fig. 111)

36b. Dorsal fin plain, or with a few scattered melanophores at its extreme tip; scales in series from lateral line to dorsal-fin origin 4-5.. ...37

37a. (36b) Branched anal-fin rays 8-10, usually 9; predorsal scales 8-9; adipose origin over base of last anal ray; humeral blotch variable, but usually vertically elongate, extending well below lateral line, and crescent shaped (opening towards head, no darker black spot included in blotch, (fig. 40a)...

Creagrutus bolivari (fig. 109)

37b. Branched anal-fin rays 10-11, rarely 12; predorsal scales 10-12; vertical through adipose-fin origin over middle of last depressed anal-fin ray; humeral blotch rounded, sometimes extending faintly vertically above lateral line, but rarely extending much below it, pigment darkest in rounded spot near lateral line, the upper part sometimes curved forward in a tight crescent, but not forming an elongate crescent, (fig. 40b)...Creagrutus cf beni (fig. 107)

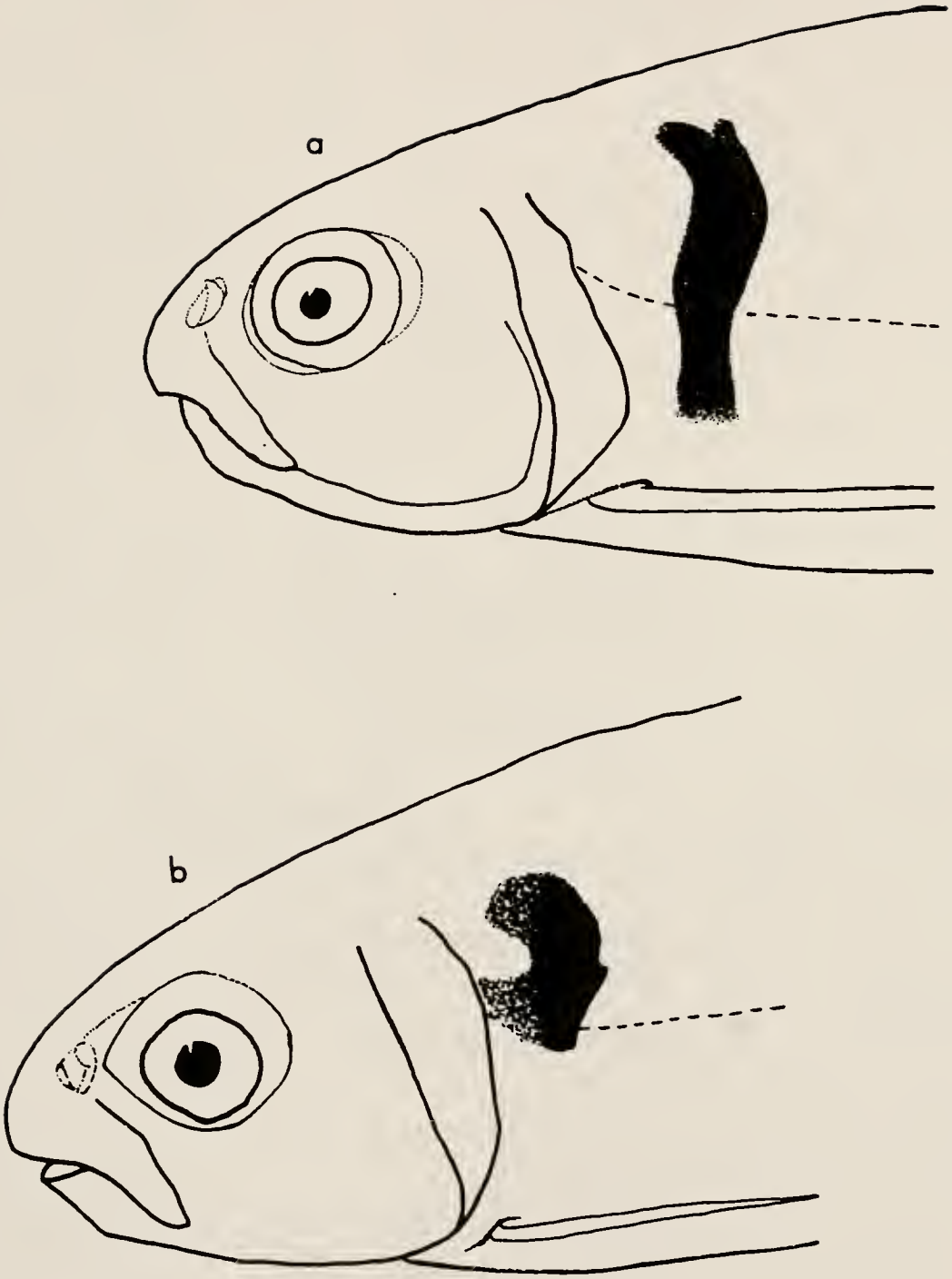


Figure 40. Humeral crescents in:
a. Creagrutus bolivari.
b. Creagrutus cf beni.

38a. (32b) Anal-fin base long, the anal fin with 40 or more rays....39

38b. Anal-fin base shorter, the anal fin with 39 or fewer rays... ...43

39a. (38a) Scales cycloid, often crenate; sides often with wavy black lines; teeth all multicuspid...Markiana geayi (fig. 161)

39b. Scales ctenoid, body rough when lightly rubbed from tail toward head; usually no wavy black lines on sides; teeth variable.....40

40a. (39b) Teeth all multicuspid, canine teeth absent; lateral-line scales 51 or fewer... Ctenobrycon spilurus (fig. 113)
(in part, this species also keys out in couplet 10a)

40b. Some teeth conical, canine teeth usually present; lateral line scales more than 51... ...41

41a. (40b) Back strongly humped, body depth usually less than three in SL; lateral-line scales over 100; lower jaw with only one row of teeth (no row of tiny teeth behind first row)...
Cynopotamus bipunctatus (fig. 115)

41b. Back only slightly if at all humped, body depth usually more than 3.3 in SL; lateral-line scales 70-84; lower jaw with a second row of tiny conical teeth behind first... ...42

42a. (41b) Black blotch usually present on chin, as well as at origin of dorsal, anal and both lobes of caudal fins; first pair of premaxillary canines (at symphysis) set closely to one another, the distance between their bases is less than the basal diameter of one tooth; branched anal rays 35-38; lateral-line scales 73-76; ectopterygoid with ventral bony crest; nasal bone tubular...
Acestrocephalus cf boehlkei (fig. 62)

42b. No blotches of black as above, but skin along edge of lower jaw usually with a well-defined row of melanophores along bases of

teeth; first canines on premaxilla not close to one another, usually separated by a distance nearly equal to their length; branched anal-fin rays 39-45; lateral-line scales 79-84; ectopterygoid without a bony ventral crest; nasal bone laminate...

Galeocharax n. sp. (fig. 119)

43a. (38b) Lateral-line scales 54 or more... ...44

43b. Lateral-line scales 53 or fewer... ...53

44a. (43a) Teeth multicuspid, never caniniform... ...45

44b. Teeth conical, caniniform or triangular, with only weak lateral cusps (if any)... ...49

45a. (44a) Upper jaw teeth arranged in three irregular rows; anal-fin rays 28 or fewer; body deeper, its depth less than 3.5 in SL....46

45b. Upper jaw teeth in only two rows; anal-fin rays more than 30; body long and slender, its greatest depth four or more in SL....48

46a. (45a) Lateral-line scales 54-56 (including those on caudal fin); caudal fin with black crescent along its base, more extensive on upper lobe; anal fin black along its base (fig. 41a); sides with horizontal rows of dots but these not forming wavy lines...

Brycon falcatus (fig. 41a)

(Note: This species is not yet reported from the Apure drainage, but is known from Guyana and the northern Amazon Basin.)

46b. Lateral-line scales 56 or more (including those on caudal fin); caudal fin with pigmentation as in fig. 41b or c, and always lacking complete black crescent along its base; anal fin with or without black along its base; posterior half of sides usually with horizontal wavy lines... ...47

47a. (46b) Body with black midlateral stripe that continues out through central caudal-fin rays to their tips in most individuals; anal fin and base not black, the fin usually gray or clear (fig. 41b)... Brycon whitei (fig. 84)

47b. Body without black midlateral stripe; caudal fin with asymmetrical diagonal band of black from caudal peduncle up through basal portion of upper lobe; anal fin with black pigment starting near base of ninth ray and intensifying posteriorly (fig. 41c)... Brycon bicolor (fig. 82)

(Note: In preservative the black pigment is usually lost.)

48a. (45b) Maxilla short, barely reaching orbit in horizontal axis, and not reaching down to ventral margin of orbit on vertical axis (fig. 42a); teeth wide and multicuspid (with at least seven uniformly-sized cusps), upper caudal lobe black on proximal half (or more), lower lobe hyaline...Iguanodectes spilurus (fig. 159)

48b. Maxilla long, extending back well beyond anterior edge of orbit, and reaching down past ventral margin of orbit (fig. 42b); teeth with central cusp much larger than others, usually tri- to pentacuspid, not particularly wide; both caudal lobes with wide dusky black border... Bryconops affinis (fig. 92)

49a. (44b) Snout neither very elongate nor tapering to a point (fig. 43a); all teeth conical or triangular, uniform in size, with no large canines standing out from rest; lateral scales 55-65; body often with horizontal rows of dots...Salminus hilarii (fig. 208)

49b. Snout very elongate, narrow, and tapering to a slender point (fig. 43b); large canine teeth present which are much larger than rest of teeth; lateral scales more than 70; body without rows of dots forming horizontal lines...Genus Acestrorhynchus (2-4 spp.) ...50

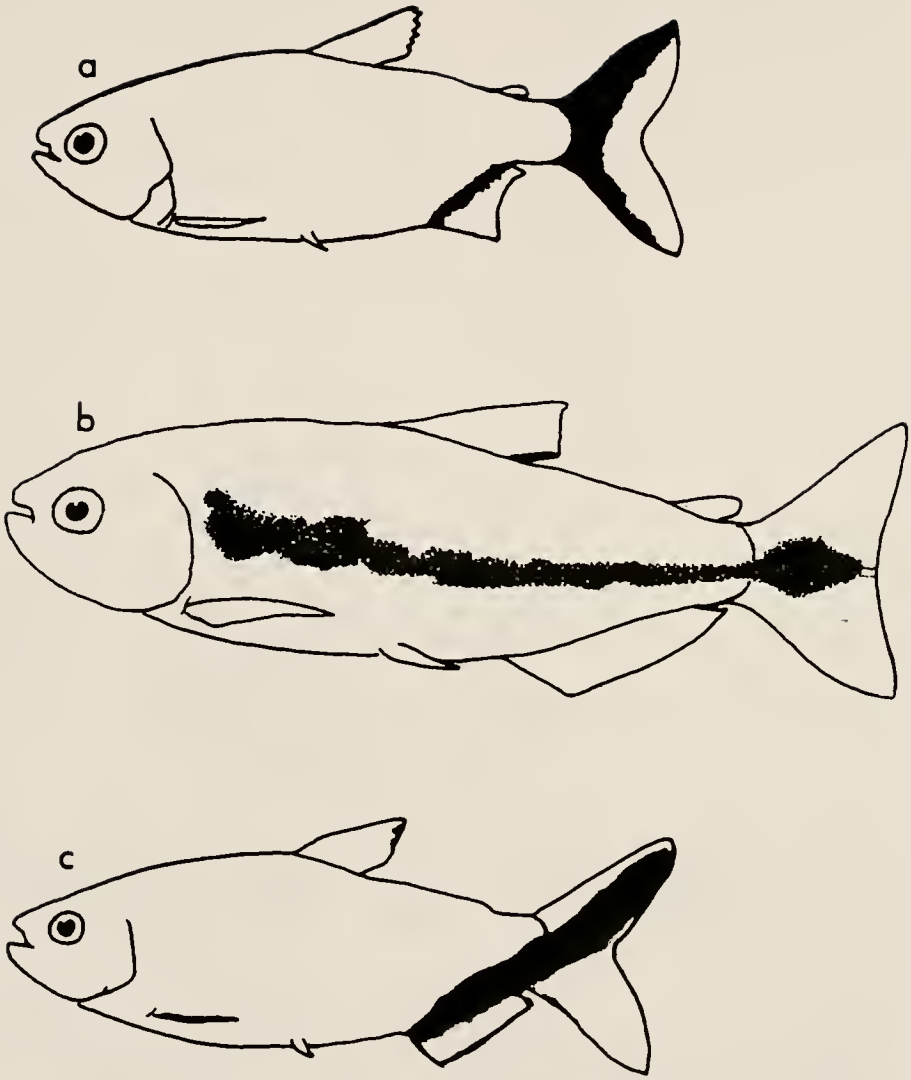


Figure 41. Pigmentation patterns in:
a. Brycon falcatus (not present in Apure Drainage).
b. Brycon whitei.
c. Brycon bicolor.

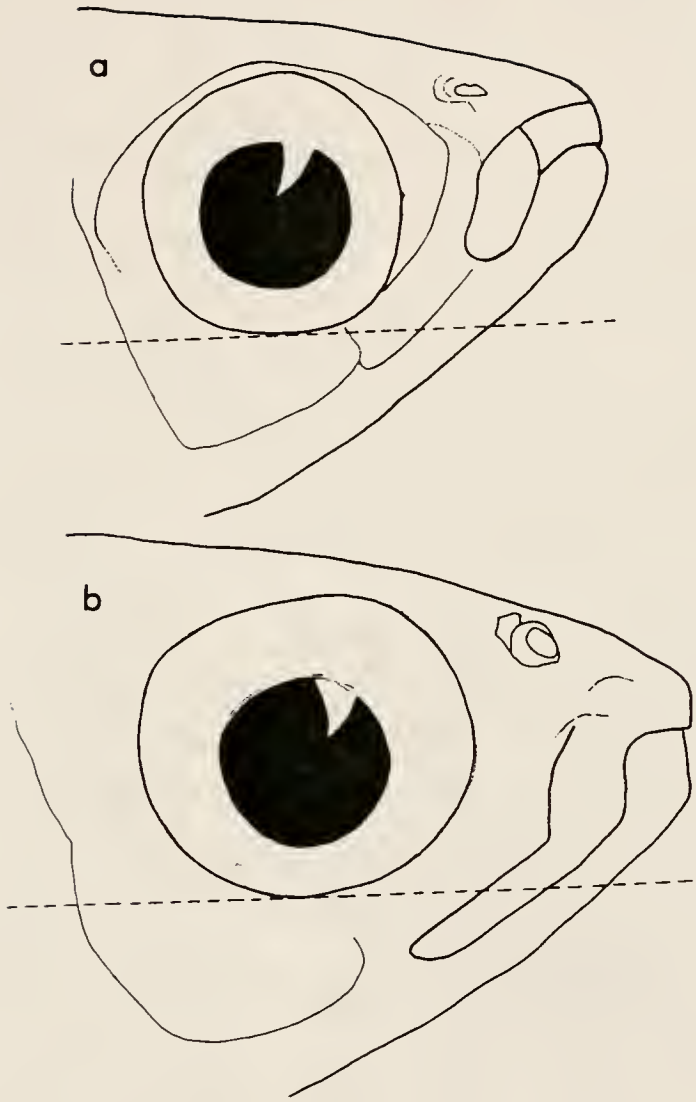


Figure 42. Maxilla length and shape in:
a. Iguanodectes spilurus.
b. Bryconops affinis.

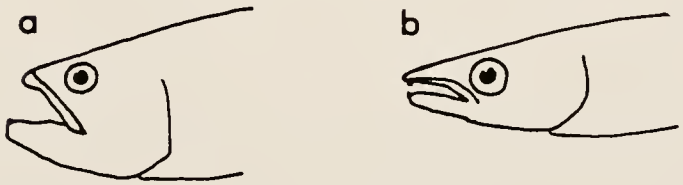


Figure 43. Snout shape in:
a. Salminus hilarii.
b. Acestrorhynchus spp.

50a. (49b) Scales very small, over 140 in lateral series and 30-38 above lateral line to dorsal-fin base; gill-rakers 30-39 on first arch; first premaxillary tooth small, often hidden in skin near base of first large canine situated just behind; opercle usually with two dark patches near posterior margin...

Acestrorhynchus falcirostris (fig. 64)

50b. Scales larger, 70-125 in lateral series and 12-22 above lateral line to dorsal-fin base; gillrakers 15-26 on first arch; first tooth on premaxilla a large canine; opercle usually without dark areas... ...51

51a. (50b) Humeral region with a large black blotch...

Acestrorhynchus falcatus (no fig.)

(Note: This species has not yet been reported from Apure drainage, but is present in the upper Orinoco and Essequibo basins.)

51b. Humeral region without a large dark blotch, though a small one sometimes present... ...52

52a. (51b) Anal-fin rays 25-31; lateral-line scales 108-122; scales above lateral line to dorsal origin 20-22; maximum size larger, reaching length of 250 mm... Acestrorhynchus microlepis (fig. 67) (Note: Two species may key here. The more common is the nominal A. microlepis, the other is a very similar form with a longer snout, called here Acestrorhynchus sp. "pico largo," which may prove to be a different species or perhaps the juveniles of A. falcirostris.)

52b. Anal-fin rays 21-25; lateral-line scales 74-85; scales above lateral line to dorsal-fin origin 12-14; a dwarf species (SL usually less than 85 mm)... Acestrorhynchus minimus (no fig.) (Note: This species is not yet reported from Apure drainage, but is present in southern Apure state).

53a. (43b) Canines present in both jaws, other teeth conical; opercle with "a bite missing" from central posterior margin (fig. 44)...

Lonchogenys ilisha (no fig.)

(Note: This species is not yet reported from the Apure drainage, but is present in southern Apure state.)

53b. No large canine teeth present in either jaw, teeth conical to multicuspid; opercle with margin normal... ...54

54a. (53b) Lateral line incomplete (only 4-10 pored scales present), not reaching level of dorsal-fin origin... ...55

54b. Lateral line complete... ...72

55a. (54a) Dorsal fin with a distinct black spot or blotch; anal fin sometimes similarly marked... ...56

55b. Dorsal and anal fins without distinct black spots, though sometimes dusky overall or edged in black... ...58

56a. (55a) A large, well-defined humeral spot present; anal fin usually plain, with 26-27 rays; teeth in two rows on premaxilla, the first (outer) row consisting of one to three tiny teeth on either side, often hidden beneath skin of upper lip...

Hyphessobrycon bentosi (fig. 155)

(Note: Some individuals, especially small ones, lack the first row of premaxillary teeth, thus placing them in the genus *Megalamphodus*, but this character hardly seems to be of generic value. It is possible that both genera are present, but few specimens are available for study. Problems involved with definition of the genera *Hemigrammus*, *Hyphessobrycon*, *Megalamphodus*, *Moenkhausia* and *Pristella* are complex and beyond the scope of this work.)

56b. No humeral spot; anal fin with or without black mark and usually with 23-25 rays; teeth in one or two rows on premaxilla... ...57

Figure 44. Anterior portion of Lonchogenys ilisha. Note the oddly curved posterior margin of opercle which seems to have "a bite missing".

57a. (56b) Premaxillary teeth all conical, long, slender and sharply pointed, and arranged in only one row; anal fin usually with black mark near tip of first (longest) rays...

Megalamphodus cf axelrodi (fig. 163) (See note in 57b.)

57b. Premaxillary teeth tri- to multicuspid, and arranged in two rows; anal fin plain... Hemigrammus cf elegans (fig. 133)

(Note: Pristella maxillaris, a species easily confused with Hyphessobrycon bentosi, Megalamphodus cf axelrodi or Hemigrammus cf elegans, could occur in the Apure drainage since it is found in eastern Venezuela. However, all specimens examined so far have lacked the toothed maxilla characteristic of P. maxillaris.)

58a. (55b) Tail with distinct, black bars on upper or both lobes (figs. 45a, b, c)... ...59

58b. Tail without black bars on its lobes, but with a central spot or blotch often present or tail plain... ...61

59a. (58a) Tail pattern as in fig. 45a; anal-fin rays 14-15; no maxillary teeth... Hemigrammus cf rhodostomus (fig. 145)

59b. Tail pattern not as above, but rather like fig. 45b or c; anal-fin rays 20-24; 1-4 maxillary teeth present... ...60

60a. (59b) Both lobes of tail with black, as in fig. 45b...

Hemigrammus marginatus (fig. 135)

60b. Only upper lobe of tail with black, as in fig. 45c...

Hemigrammus sp. "arriba" (fig. 149)

61a. (58b) Caudal peduncle and tail plain, sometimes with edges or basal area dusky, but never with a distinct midbasal spot... ...62

61b. Caudal peduncle and/or tail with a distinct spot or blotch centered at base, or embedded (pigment not on surface, but deeper in flesh) at base of each lobe... ...67

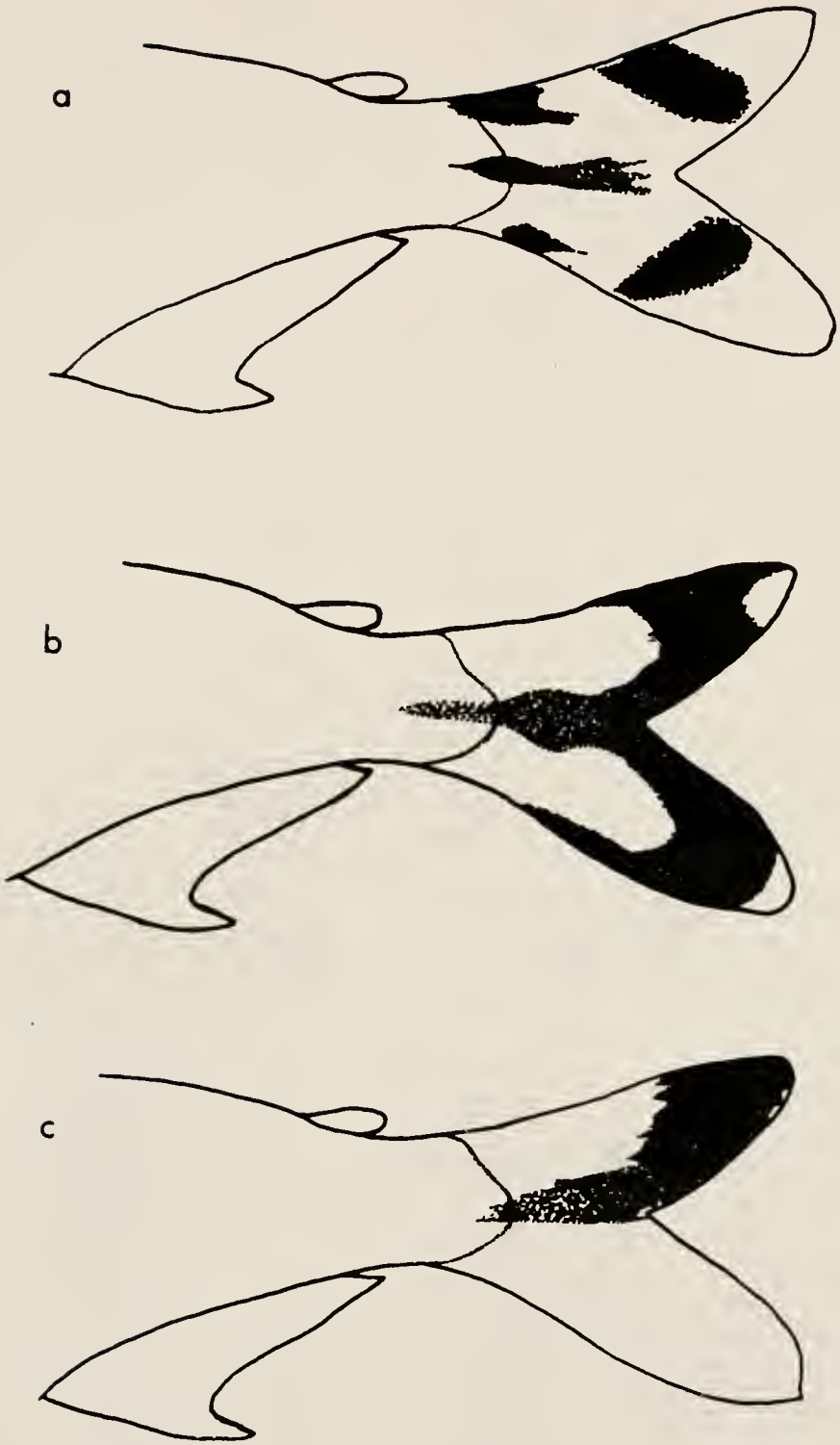


Figure 45. Caudal pigmentation patterns in:
a. Hemigrammus cf rhodostomus.
b. Hemigrammus marginatus.
c. Hemigrammus sp. "arriba".

62a. (61a) Premaxillary teeth numerous, more than seven on either side, slender and pointed, arranged in a single row, lateral cusps weak if present; maxilla with teeth along most of its length, more than five in number; no black lateral midline along sides nor other black markings; tail red or pink in life...

Aphyocharax alburnus (fig. 69)

62b. Premaxillary teeth less numerous, usually no more than five on either side, tri- to multicuspid and arranged in two rows; maxilla with teeth restricted to area near connection to premaxilla, fewer than five in number, if present at all; pigmentation on body variable, but usually with black markings of some kind; tail red or not... ...63

63a. (62b) A tiny plain fish (usually less than 20 mm SL), only markings are two faint embedded crescents at base of each caudal lobe and a few scattered melanophores on tip of upper caudal lobe (fig. 46); anal-fin rays 19-21...Hemigrammus cf mimus (fig. 141) (Note: Hemigrammus mimus, named for its similarity to a species of Microschemobrycon, was described from specimens with only 17 anal-fin rays. Apure drainage specimens have 19-21.)

63b. Tiny to small fishes (adults usually 20-45 mm SL) with various pigmentation patterns, but never with embedded crescents of pigment base of each caudal-fin lobe; anal-fin rays 16-27... ...64

64a. (63b) Anal-fin rays 22-27; pored scales in lateral line 14-15, usually reaching as far back as pelvic fins... ...65

64b. Anal-fin rays 16-22; pored scales in lateral line 8-10, not extending much beyond the pectoral fins, if that far... ...66

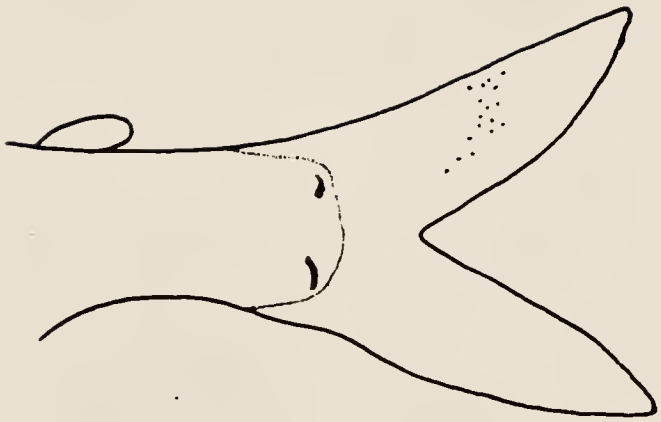


Figure 46. Caudal pigmentation in Hemigrammus cf mimus.

65a. (64a) Anal fin with a dark black line near and parallel to its base, strongest anteriorly, and with edge of fin often black as well (fig. 47); humeral spot over third scale in lateral line; anal-fin rays 22-24; caudal peduncle without red in life, although tail may be red... Hemigrammus barrigonae (fig. 131)
(in part, see couplet 70a)
(Note: Some H. barrigonae have a complete lateral line, in which case they will probably key to Moenkhausia copei, couplet 81a.)

65b. Anal-fin base lacking dark black line near its base, and no black on margin of fin; sometimes with a weak first humeral spot, followed by a second stronger spot over fifth to seventh scale in lateral line; anal rays 25-27; caudal peduncle brilliant pink or red in life; caudal fin either plain or red near base...
Hemigrammus stictus (fig. 151)

66a. (64b) Anal-fin rays 16 or fewer; usually only one multicuspid maxillary tooth... Hemigrammus cf analis (fig. 129)
(in part, see also couplet 34b)

66b. Anal-fin rays 18 or more; usually two, sometimes three multicuspid maxillary teeth... Hemigrammus microstomus (fig. 139)

67a. (61b) Caudal fin with embedded crescent of black pigment at base of each lobe (fig. 48); premaxillary teeth in one row; humeral spot absent... Microschemobrycon casiquiare (fig. 171)

67b. Caudal fin not pigmented as above; premaxillary teeth in two rows; humeral spot sometimes present... ...68

68a. (67b) Caudal spot extremely large, wide and high, covering entire caudal peduncle and much of tail (fig. 49); caudal spot weakly continuous with black midlateral stripe...
Hemigrammus newboldi (fig. 143)
(Formerly known as Ramirezella newboldi.)

Figure 47. Pigmentation pattern of Hemigrammus barrigonae.

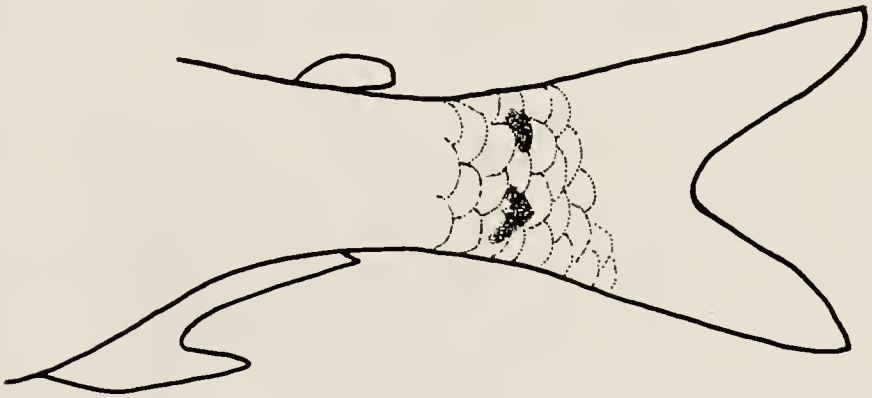


Figure. 48. Caudal pigmentation of Microschemobrycon casiquiare.

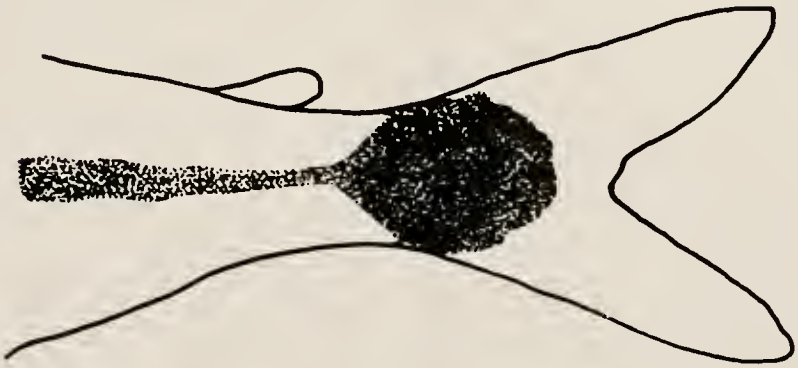


Figure. 49. Caudal pigmentation of Hemigrammus newboldi.

68b. Caudal spot smaller than above, restricted either to tail or caudal peduncle or centered at base of tail, but never covering most of caudal peduncle and tail; caudal spot usually not continuous with lateral stripe if latter is present... ...69

69a. (69b) Lateral line very short, with 6-7 pored scales and reaching only to over middle of depressed pectoral fin; a wide, dusky lateral band along sides (fig. 50), continuing through lower half of the caudal peduncle onto central caudal rays; body heavily pigmented in general, in many individuals the lower half of body is black or dusky... Hyphessobrycon metae (fig. 157)

69b. Lateral line slightly longer, with 8-10 pored scales, and usually reaching beyond pectoral-fin tips; no wide black band as above, although a thin midlateral stripe often present; body pigmentation variable, but usually not with lower half more heavily pigmented as above... ...70

70a. (69b) Body deep, its greatest depth 2.5-2.8 in SL; caudal spot barely noticeable; black midlateral stripe present; base of anal fin with a distinct black line, this fin often edged in black as well (fig. 47)... Hemigrammus barrigonae (fig. 131)
(in part, see couplet 65a)
(Note: This species is very similar to Moenkhausia copei, see couplet 81a.)

70b. Body slender, its greatest depth 3.3 to 4.0 in SL; caudal spot obvious, well developed (fig. 51); usually either a strong black midlateral stripe present or a strong line present at base of anal, but not both... ...71

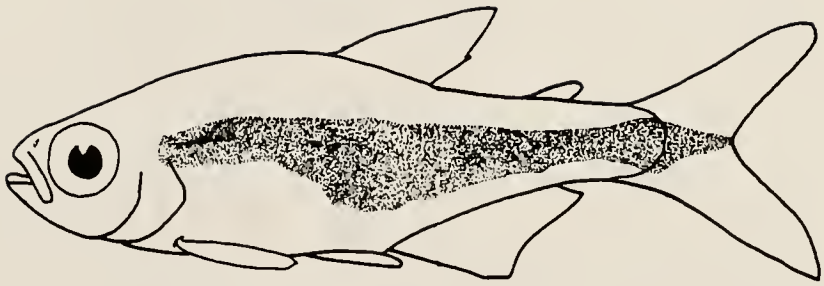


Figure 50. Pigmentation of Hyphessobrycon metae.

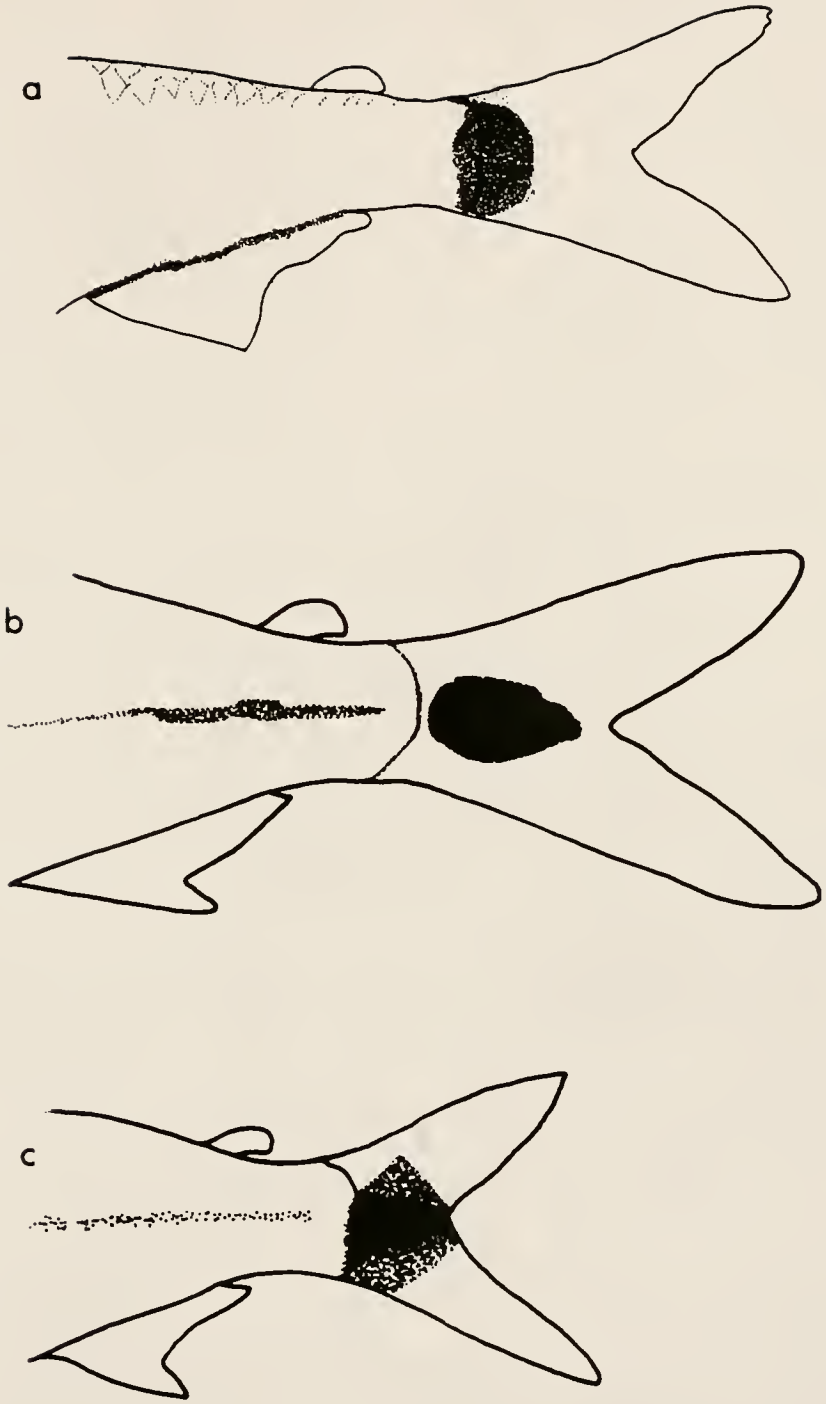


Figure 51. Posterior pigmentation patterns in:
a. Hemigrammus cf schmardae.
b. & c. Hemigrammus micropterus.

71a. (70b) A distinct black line along base of anal fin (fig. 51a); caudal spot vertically elongate, as high as caudal peduncle, with more pigment on peduncle than on tail; pored section of lateral line longer, reaching to over middle of pelvic fins; midlateral stripe absent or very weak, consisting only of isolated chromatophores; a dwarf species, the largest specimen only 25 mm SL, and most less than 20 mm SL...

Hemigrammus cf *schmardae* (fig. 147)

71b. No distinct black line along base of anal; caudal spot triangular and horizontally elongate, passing to tips of central caudal rays in some individuals (fig. 51b), or extended vertically (fig. 51c), in which case there is more pigment on tail than on caudal peduncle; pored section of lateral line shorter, usually not, sometimes barely reaching the pelvic-fin insertion; a distinct, thin black midlateral stripe present, strongest posteriorly, but not continuous with caudal spot; a small species, reaching about 40 mm SL... *Hemigrammus micropterus* (fig. 137)

72a. (54b) Lateral line normal, not strongly decurved, extending back from opercle more or less along mid-axis of body to mid-base of caudal fin or (in some species) slightly decurved, but never so low as to pass within 1-4 scales of anal-fin origin, and passing nearer to mid-axis of body (an imaginary line through eye and midbase of caudal fin) than to anal-fin origin... ...76

72b. Lateral line strongly decurved (fig. 52), starting near upper opercle, then curving down to within 1-4 scales of anal-fin origin, and passing nearer to anal-fin base than to mid-axis of body....73

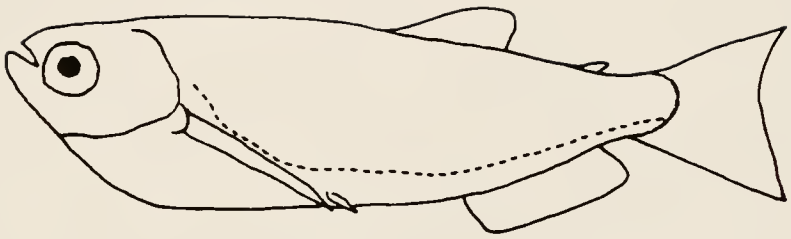


Figure 52. Decurved lateral line (of Triportheus sp.).

73a. (72b) Abdomen rounded or flat, never keeled; pectoral fins not greatly enlarged; premaxilla with two rows of teeth; (usually only two teeth on either side in the outer row, five in the inner row); dentary with only one row of teeth; body anchovy-like in shape (fig. 117)... Engraulisoma cf taeniatum (fig. 117)

73b. Abdomen in prepelvic region narrowed to form sharp-edged keel; pectoral fins enlarged; premaxilla with three rows of teeth; dentary with two rows of teeth (the second "row" actually just two conical teeth behind main row near the symphysis); body not anchovy-like in shape... genus Triportheus (three spp.)... ...74

74a. (73b) Scales above lateral line seven to dorsal-fin origin (counting all scales, large or small)...

Triportheus sp. "cola roja" (fig. 228)

(Note: Color in this species is quite variable among and between populations. The body can be plain or spotted, and the tail is usually red, but often with a central black stripe.)

74b. Scales above lateral line to dorsal-fin origin 5-6... ...75

75a. (74b) Body relatively deep, its depth less than three in standard length; central caudal rays usually black, often elongated; usually six transverse scales above lateral line; body often with rows of black dots... Triportheus angulatus (fig. 226)

75b. Body long and slender, its depth about 3.4 in standard length; caudal fin often yellow, with concave distal margin edged in black usually five transverse scales above lateral line, but sometimes a small sixth scale at dorsal origin; body plain, silvery...

Triportheus albus (fig. 224)

76a. (72a) Premaxillary teeth in one row... ...77

76b. Premaxillary teeth in two rows... ...78

77a. (76a) Premaxillary teeth usually with nine cusps, dentary teeth usually with seven points, the central cusp larger and higher than the rest (fig 53a); anal-fin rays 21-25 (usually 22-23); 11 transverse scale rows (from pelvic-fin insertion to dorsal-fin origin)... Cheirodon pulcher (fig. 100)

(Note: There is still some debate as to the correct generic name for this species, which was formerly known as Odontostilbe, Géry (1977) used the latter name for those species with a complete lateral line.)

77b. Premaxillary and dentary teeth usually five-pointed, the outer cusps on each tooth minute, and the dentary teeth with three flat central cusps of same size and height (fig. 53b); anal-fin rays 23- 27 (usually 25-27); usually only nine transverse scales rows... Cheirodontops geayi (fig.102)

78a. (76b) Anal-fin rays 18-25... ...79

78b. Anal-fin rays 26 or more... ...82

79a. Anal-fin rays 24-25; black line absent along anal-fin base... Bryconamericus sp. (fig. 86)

79b. (78a) Anal-fin rays 18-23; black line either present or absent along anal-fin base... ...80

80a. (79a) Upper caudal-fin lobe black with lighter spot near base... Moenkhausia lepidura complex (fig. 179)

(in part, see also couplet 95b)

80b. Caudal lobes both plain, hyaline, neither black nor barred; central rays of caudal fin sometimes dark, or with a diffuse basal crescent... ...81

Figure 53. Multicuspid teeth of:
a. Cheirodon pulcher,
b. Cheirodontops geayi.
Teeth on the left are from the upper jaw, those on the right are from the lower jaw.

81a. (80b) A distinct black line present at base of anal fin; humeral spot horizontally elongate; anal rays 21-23; inner premaxillary row with five teeth; maxilla with four small narrow teeth...

Moenkhausia copei (fig. 175)

(Note: This species is very similar to Hemigrammus barrigonae, and since the latter often has a complete lateral line, they are easily confused. The traditional character used to distinguish Moenkhausia species, a scaled caudal fin is often unreliable and impractical. Many Hemigrammus have partially scaled caudal fins, and most Moenkhausia lose part or all of the caudal scales when preserved. M. copei has only five rows of transverse scales between the lateral line and the dorsal origin (vs. six or seven in H. barrigonae), and has a longer snout, a more slender body, and a more falcate anal fin.)

81b. No black line at anal-fin base; humeral spot vertically elongate; anal-fin rays 18-20; inner premaxillary row with four teeth; maxilla with two wide, seven-pointed teeth...

Bryconamericus deuterodonoides (fig. 90)

82a. (78b) Anal-fin rays 35-37... ...83

82b. Anal-fin rays 34 or fewer... ...86

83a. (82a) Body more elongate, its greatest depth more than 2.8 in SL; maxilla with numerous (more than eight) slender teeth; premaxilla with small numerous (six or more) teeth in main row; preventral area flat and with an unusual arrangement of exceptionally large scales that overlap on the ventral midline and are curved up or bent at their distal edge, small auxiliary scales present along ventral midline (on top of larger scales)... Phenacogaster cf megalostictus (fig. 192)

83b. Body deep, its greatest depth less than 2.5 in SL; maxilla with up to four teeth, if any; premaxilla with 4-5 robust teeth on each side in inner row; preventral area rounded to slightly flattened; abdominal scales (from between pelvic-fin insertions to between pectoral fin origins) arranged in normal rows... ...84

84a. (83a) Caudal peduncle with very large black spot; lateral line slightly decurved anteriorly, dropping down two or three scales immediately behind upper opercle where it begins (fig. 54)...
Tetragonopterus argenteus (fig. 222)

84b. Caudal peduncle without spot; lateral line straight, not decurved anteriorly... ...85

85a. (84b) Anal-fin with first rays black and often extended as filaments, other fins plain (fig. 55); a predorsal spine embedded in flesh just anterior to dorsal origin; lateral-line scales about 37... Poptella orbicularis (fig. 196)

85b. First anal-fin rays neither black nor filamentous, all fins often reddish in life; no predorsal spine; lateral-line scales about 32... Gymnocorymbus thayeri (fig.125)

86a. (82b) Pelvic bones elongate, spine-like, and projecting anteriorly through wall of abdomen in front of pelvic-fin insertions (or visible just beneath the skin); predorsal midline partly naked; no spot on caudal peduncle or tail; a distinct round humeral spot present, with faint dorsal and ventral vertical extensions, surrounded by a white area, and placed farther back on the side than in most Astyanax, about midway between the posterior margin of opercle and dorsal-fin origin...
Astyanax polylepis (fig. 77)

[tail scaled at base; lateral-line scales 38-42; anal-fin rays 27-29.]

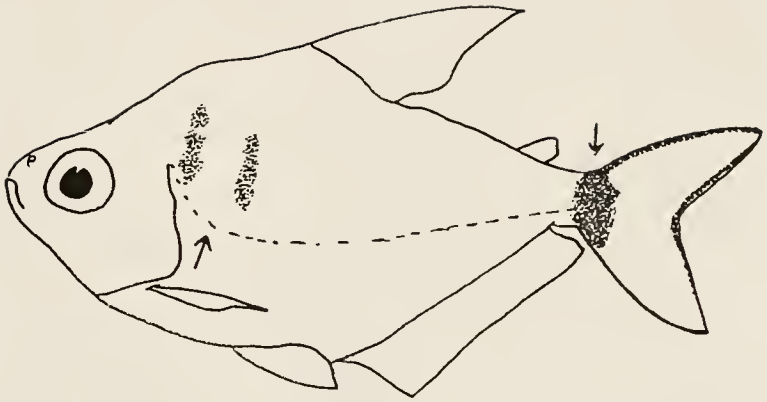


Figure 54. Slightly decurved lateral line of Tetragonopterus argenteus.

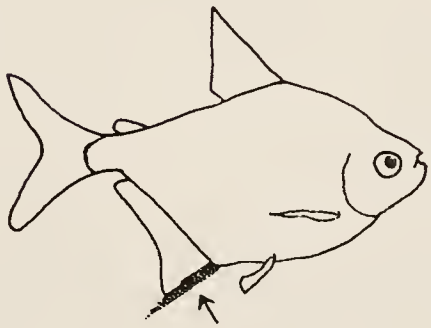


Figure 55. Anal-fin pigmentation of Poptella orbicularis.

86b. Pelvic bones not elongate nor projecting out through body wall in front of pelvic-fin insertions; predorsal midline usually normally scaled (ie. with a row of scales right down the midline), but if partly naked then caudal peduncle with distinct horizontally elongate spot (in A. bimaculatus); humeral spot usually present, but seldom surrounded by paler whitish area, and placed farther forward, nearer to opercle than to dorsal-fin origin... ...87

87a. (86b) Lateral-line scales 46-54... ...88

87b. Lateral-line scales 29-45... ...89

88a. (87a) Upper caudal-fin lobe not black, caudal fin red in life, sometimes with a black stripe through central rays (even in faded preserved specimens a few melanophores on central caudal rays are usually visible with magnification); a distinct double humeral bar or spot usually present, the first vertically elongate with a more intense ovate spot at level of pupil, the second fainter, and also vertically elongate; maxilla short, barely (or not) reaching posteriorly to a vertical line through anterior margin of pupil; eye smaller, measuring more than 2.9 times in HL; BD greater, usually less than 3.0 in SL...

Astyanax integer (fig. 73)

[Predorsal series of scales normal, complete.]

88b. Upper caudal-fin lobe black with a bright orange or yellow basal spot (whitish in preserved specimens) no humeral spot; maxilla longer, reaching posteriorly to below center of pupil of eye; eye large, usually measuring less than 2.9 times in HL; BD less usually 3.5 - 4.0 in SL... Bryconops melanurus (fig. 94)

89a. (87b) Anal-fin base with black oblique stripe that passes through caudal peduncle at an angle and continues up into upper lobe of caudal fin (fig. 56). (in faded preserved specimens, asymmetrical black pigment is usually visible at least on the tail with slight magnification)... Astyanax metae (fig. 75)

[Lateral-line scales 39-41; anal-fin rays 27-33; caudal fin scaled only near at base.]

89b. Pigmentation pattern not as in 89a... ...90

90a. (89b) Inner premaxillary row with four teeth (since this character is somewhat variable, count the teeth on both sides of the jaw in several specimens to be sure); second suborbital in contact with the preoperculum below and covering cheek... ...91

90b. Inner premaxillary row with five teeth; second suborbital leaving a naked area between it and lower limb of preoperculum... ...93

91a. (90a) Lateral-line scales 41-44; maxilla with up to 20 teeth along most of its length (the number increasing with age)... Hemibrycon metae (fig. 127)

91b. Lateral-line scales 36-39; maxilla with 1-3 wide teeth at proximal end... ...92

92a. (91b) Lateral stripe continuing uninterrupted through caudal peduncle onto tail (fig. 57); anal-fin rays usually 27 to 30, rarely 26 or 31... Bryconamericus beta (fig. 88)

92b. Lateral stripe fading out on caudal peduncle, the caudal-fin base with faint crescent of pigment (fig. 58); anal-fin rays 24 or 25, rarely 26 or 27... Bryconamericus sp. (fig. 86)

(in part, also keys out in couplet 79a)

93a. (90b) Lateral-line scales 33-35; both caudal-fin lobes extensively scaled (scales often lost in poorly preserved specimens).....94

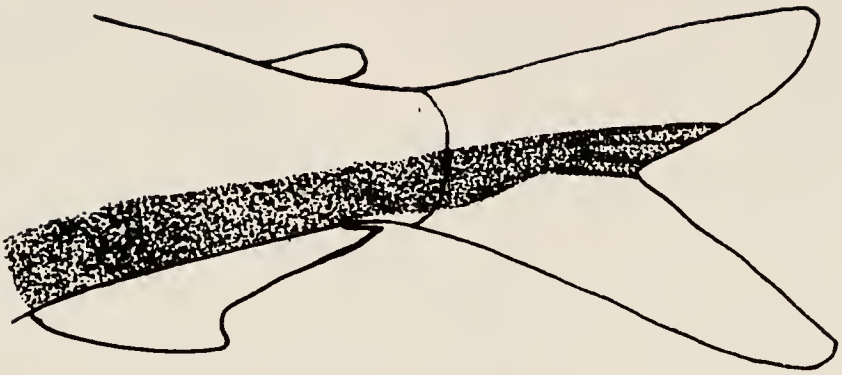


Figure 56. Caudal pigmentation in Astyanax metae.

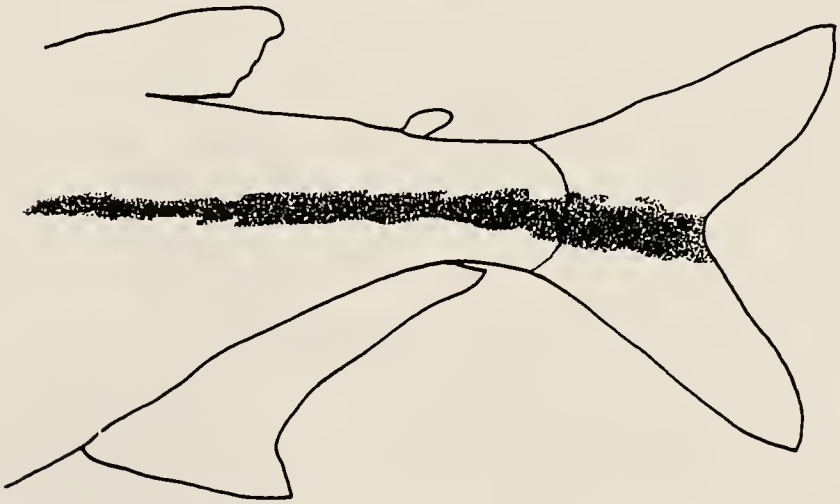


Figure 57. Caudal pigmentation of Bryconamericus beta.

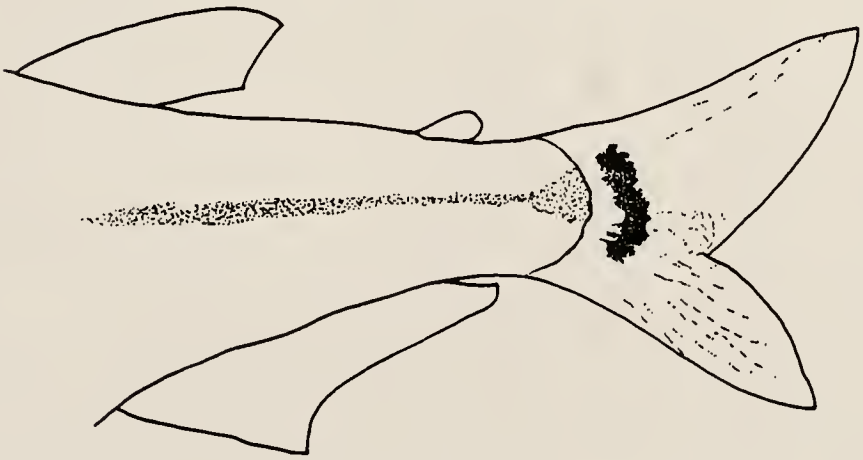


Figure 58. Caudal pigmentation of Bryconamericus sp.

93b. Lateral-line scales 36 or more; caudal fin at most scaled only near base... ...96

94a. (93a) Tail plain, sometimes dusky; first humeral spot dark and distinct, highlighted by surrounding lighter area; second humeral bar faint and vertically elongate; body depth 2.0 - 2.1 in SL... *Moenkhausia chrysargyrea* (fig. 173)

94b. Tail with black bars on upper, or both lobes (figs. 59 or 60); first humeral spot faint or absent; no second humeral spot; BD 2.6 or more in SL... ...95

95a. (94b) Tail with black bars on both lobes (fig. 59a), tips of tail often milk-white... *Moenkhausia dichroura* (fig. 177)

95b. Only the upper lobe of caudal fin black, tips not white (fig. 60)... *Moenkhausia lepidura* complex (fig. 179) (in part, also keys out in couplet 80a)
(Note: This is very similar to *M. dichroura* in morphometric and meristic characteristics, and perhaps may only represent local variation in color pattern and not distinct species.)

96a. (93b) Predorsal midline partially to completely naked, the scales from either side sometimes irregularly overlapping or touching, but the row down the midline mostly absent... *Astyanax bimaculatus* (fig. 71)
[Humeral spot distinct, horizontally ovate. Caudal peduncle with horizontally elongated spot that extends weakly onto mid-caudal rays.]

96b. Predorsal midline with normal series of scales... ...97

Figure 59. Caudal pigmentation in Moenkhausia dichroura.

Figure 60. Caudal pigmentation in Moenkhausia lepidura complex.

97a. (96b) Sides of body with distinct, black, wavy (< shaped) lines (fig. 61); humeral spot horizontally ovate, distinct, not usually vertically elongate; up to six teeth on proximal end of maxilla... Astyanax superbus (fig. 61)

97b. No wavy lines on sides of body; humeral spot vertically elongate and often diffuse; only 1-2 teeth near proximal end of maxilla... Astyanax venezuelae (fig. 80)

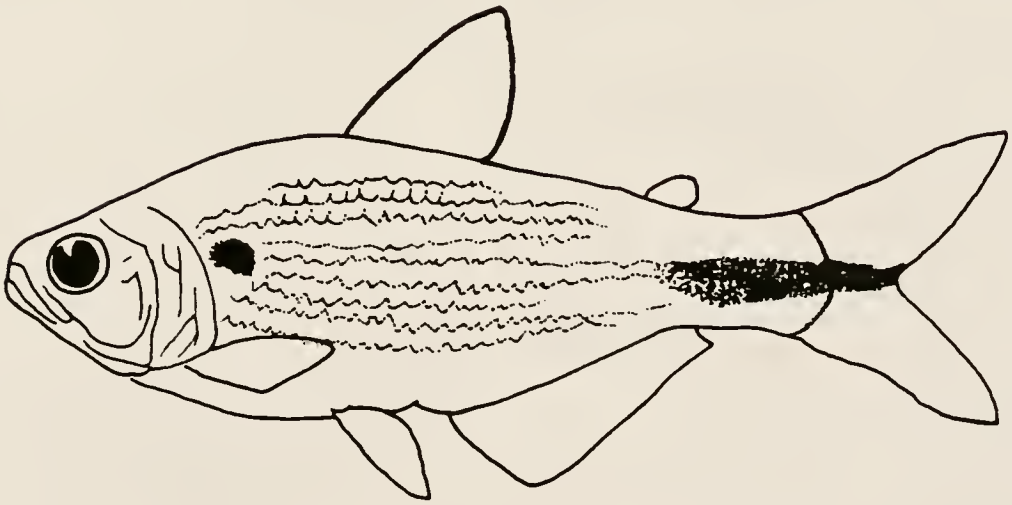


Figure 61. Astyanax superbus.

Species Accounts

Acestrocephalus cf boehlkei Menézes 1977

Dientón Alargado - Pike Characin

Fig. 62. Map: fig. 63. Couplet 42a.

Generic synonymy

Acestrocephalus Eigenmann 1909b:316 (type species: Xiphorhamphus anomalus Steindachner 1879a:48; Eigenmann 1910:447; Menézes 1976:37 (synonymy).

Specific synonymy

Acestrocephalus boehlkei Menézes 1977:185-193, fig.1 (type locality: Río Punino, trib. to Río Payamino [Napo River drainage, Amazon River Basin], above Coca, Ecuador), (seen).

Types. Holotype: MCZ 51473. Paratypes: MCZ 51474 (2), 51475 (1); MZUSP 12993-94 (2), 12995 (1),12996-98 (3); USNM 216140 (1), 216141 (1); ANSP 134500 (5).

Comments. Only three species of Acestrocephalus are known: A. anomalus (Steindachner 1879), A. sardina (Fowler 1913b) and A. boehlkei Menézes 1977. The nominal A. boehlkei is known from isolated upper tributaries of the Amazon in Brazil and the Rio Ventuari drainage in the upper Orinoco Basin in Venezuela. Comparison with the literature shows that Amazonian specimens differ slightly in pigmentation and some of the counts from specimens from the Apure drainage. More specimens and a direct comparison with the types are necessary to determine the true status of the Apure drainage population, which probably represents a new species.

Etymology. ACESTRO = a thick needle, referring to the canine teeth, CEPHALUS = head; BOEHLKEI = named to honor the late Dr. James Böhlke, a North American ichthyologist who dedicated many years of study to South American fishes.

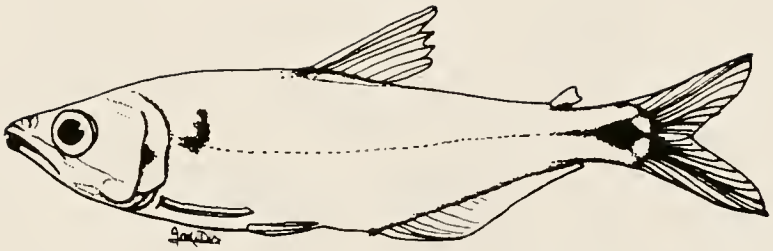


Figure 62. Acestrocephalus cf boehlkei.

Description

Illustrations. Fig. 62; Menézes 1977: fig. 1, photo of paratype.

Diagnosis. This species is distinguished from Galeocharax sp., the most similar species in the Apure drainage, by the presence of black pigment on the chin and at the origins of the dorsal and anal fins when small. Adult specimens can be distinguished by having fewer branched anal-fin rays (35-38 vs 39-45) and fewer lateral-line scales (73-76 vs. 79-84). It is further distinguished in having the first pair of premaxillary canines (at the symphysis) very closely set, instead of separated by a distance nearly equal to their length in Galeocharax sp. See Menézes (1977) for additional osteological characters that separate Acestrocephalus from Galeocharax. This species differs from the other cynopotamine characids of the Apure drainage in lacking the characteristically "humped" dorsal profile.

Size. It reaches about 150 mm SL, but most individuals are between 80-100 mm.

Morphology. This fish is a slender (BD more than 3.3 in SL) medium-sized cynopotamine characid, with ctenoid scales and a smoothly sloping dorsal profile that is not much more curved than the ventral. The snout is elongate but not greatly narrowed, the maxilla is prominent and heavily toothed (30-45). The dentary has a second row of tiny conical teeth behind the first. The cleithrum is not notched.

Counts. DR ii9; PR i15; VR i7; LLS 73-76.

Pigmentation. Most small specimens have a black dot or blotch at the tip of the chin, at the base of the dorsal and anal fin origins, and at the base of the upper and lower caudal lobes. These are lost in most adults. The body is light brown in alcohol, but silvery in life, with a faint

humeral spot and a weak, blackish lateral stripe that is strongest behind the level of the dorsal fin, and widens to form a faint blotch on the caudal peduncle. The fins are all hyaline, but the caudal fin has a black crescent at its base.

Distribution and Natural History

Range. This species is known from the Río Napo Río Payamino and Río Coca en Ecuador, the Río Tulumayo in Peru (Menézes 1977).

Apure distribution. Map: fig. 63. *A. boehlkei* is known only from the lower portion of the Apure drainage. Although it is taken infrequently, the localities are well separated and encompass the entire lower drainage.

Habitat. It occurs near shore in the main river channel of the Apure and other large lowland rivers, often in or near aquatic vegetation.

Abundance. UNCOMMON. Only 13 collections at just a few localities produced specimens of this species, but since it inhabits main river channels where sampling was seldom undertaken during this study, its abundance is probably greatly underestimated by the above figures.

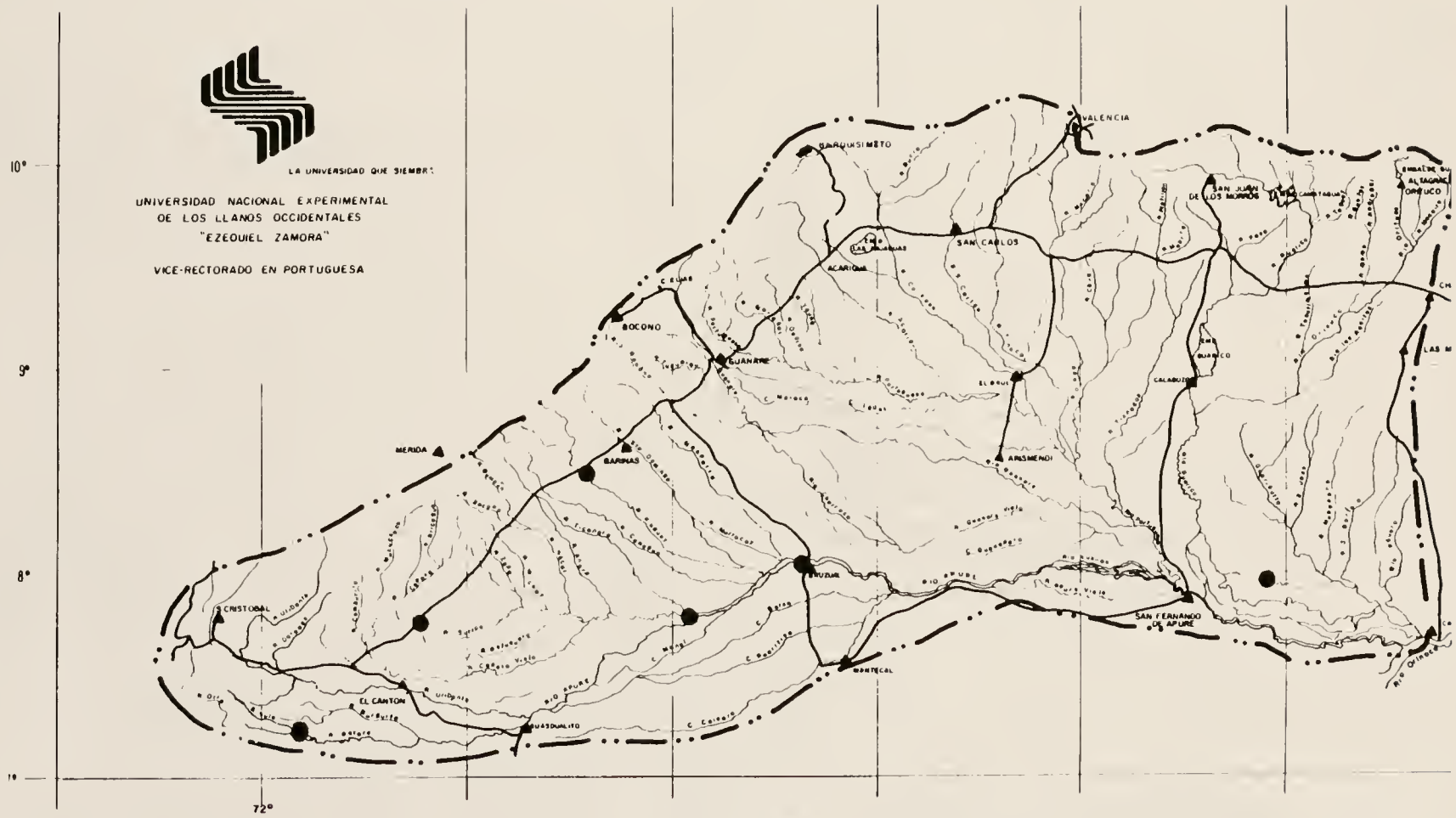
Number of specimens examined. 80 from 13 collections.

Food. CARNIVORE. It is probably mainly piscivorous.

Reproduction. Probable strategy: rl. Though this species spawning habits are unknown, small (20-30 mm SL) juveniles are present from May and September, indicating that it spawns throughout the wet season, and perhaps all year long.

Migrations. Since this species inhabits the main river channels, long migrations are not expected, but it probably makes local movements to avoid low water conditions during the dry season.

Figure 63. Apure drainage distribution of Acestrocephalus cf boehlkei.



CUENCA DEL RIO APURE

Acestrorhynchus falcirostris (Cuvier) 1819

Care'perro, Picúa - Pike Characin

Fig. 64. Map: fig. 65. Couplet 50a.

Generic synonymy

Acestrorhynchus Eigenmann & Kennedy 1903:527 (new name for Xiphorhynchus Agassiz, preoccupied in Aves, Swainson 1827, and for Xiphorhamphus Müller & Troschel preoccupied in Aves, Blyth 1843); Eigenmann 1903:146 (type species: Salmo falcatus Bloch 1794:120, by subsequent designation of Eigenmann 1910:447); Menézes 1969:33 (diagnosis, synonymy).

Xiphorhynchus Agassiz 1829:76 (type species: Salmo falcatus Bloch, by subsequent designation of Jordan & Evermann 1917:132).

Xiphorhamphus Müller & Troschel 1844:92 (type species: Salmo falcatus Bloch, by subsequent designation of Jordan 1919:221).

Sphyraenocharax Fowler 1906:460. (type species: Xiphorhamphus abbreviatus Cope 1878:687, by original designation).

Specific synonymy

Hydrocyon falcirostris Cuvier 1819:361 (type locality: Brazil), (seen).

Xiphorhynchus falcirostris Agassiz 1829:76; Cuvier & Valenciennes 1849:341.

Hydrocyon armatus Schomburgk 1841 pl. 25 (not the description).

Xiphorhamphus falcirostris Müller & Troschel 1844:92 (Brazil: description).

Acestrorhynchus falcirostris Fowler 1906:462; 1914:254 (British Guiana); Fernández Yépez 1955:3 (Venez.); Menézes 1969a:219 (synonymy, diagnosis, Venezuelan specimens cited from Guariquito and Chimire rivers, Guárico state) Mago L. 1970:69; Géry 1977:320 (diagnosis); Menézes & Géry 1983:590 (key); Román 1985:162 (diagnosis).

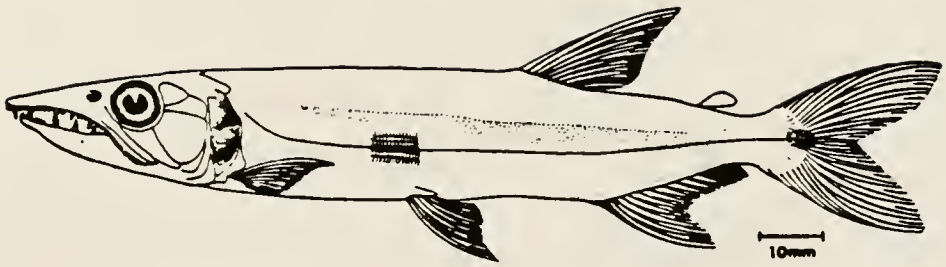


Figure 64. Acestrorhynchus falcirostris. Drawing from Menézes (1969).

Comments. More specimens must be examined to be certain that this species is the same as that reported for the Amazon drainage. Menézes (1969b) reported no significant differences in body proportions among specimens he examined from the Amazon, Orinoco and Essequibo rivers, but did note a trend to an increase in number of scales from north to south and a few minor count differences. He had very little comparative material.

It is possible that the following "species" listed as A. sp. "pico largo" (meaning long snout in Spanish) are merely juveniles of this species, but they differ in counts and dentition, and no similar adults were found at the site where they were taken.

Etymology. ACESTRO = a thick needle, referring to the canines, RHYNCHUS = jaws; FALCI = sickle shaped, ROSTRIS = snout.

Description

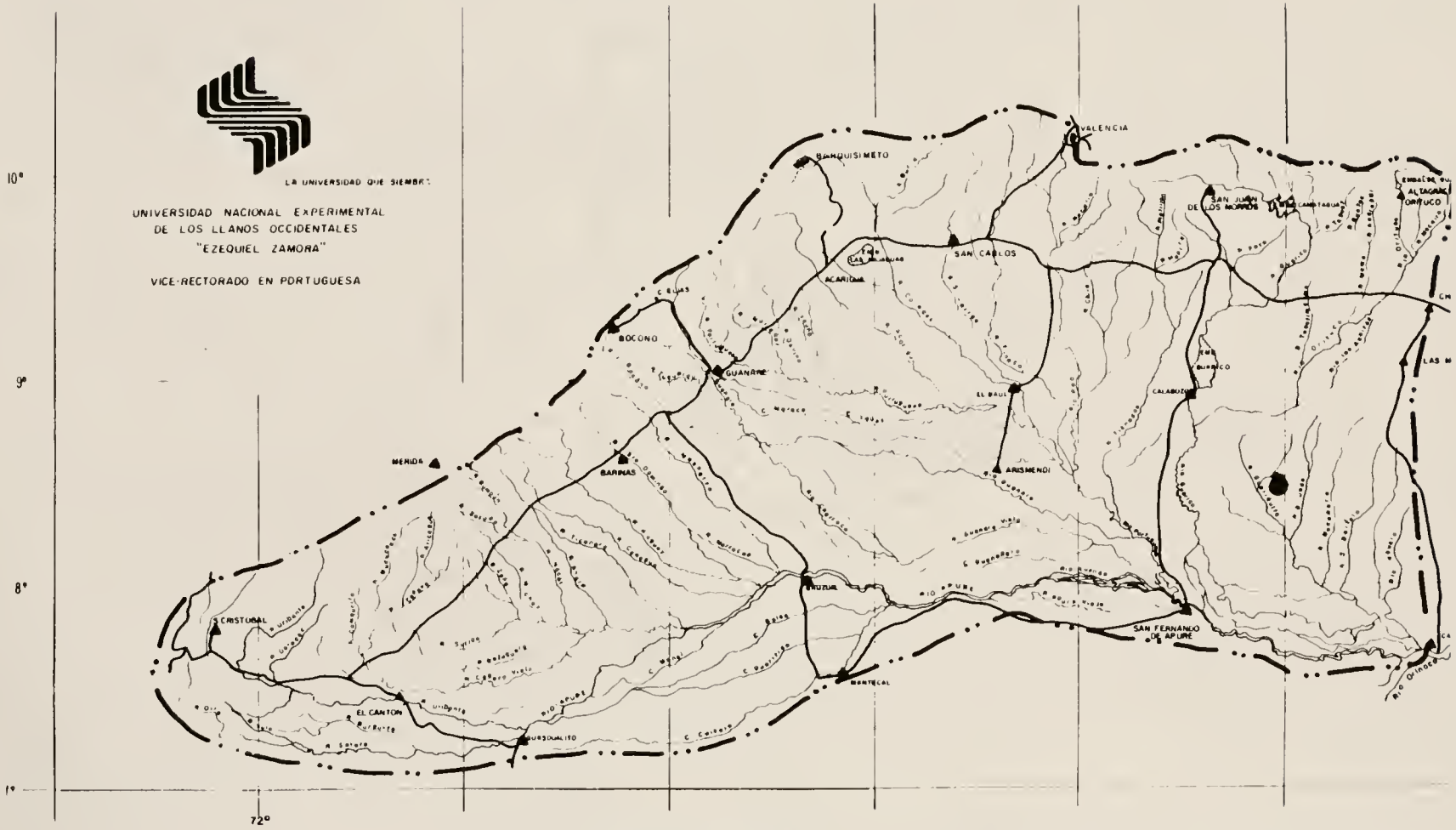
Illustrations. Fig. 64; Menézes 1969b:figs. 43, 61f; Géry 1977:320. Román 1985:162.

Diagnosis. This species is distinguished from other Acestrorhynchus by the presence of a small conical tooth, sometimes hidden under a flap of skin, located anteriorly to the first large canine of the premaxilla. It is also somewhat more elongate and slender than most species. The maximum body depth measures 5.9-6.2 times in the SL (Géry 1977). In general appearance it is otherwise similar to A. microlepis.

Size. Although reported to reach 400 mm SL (Géry 1977), specimens of that size are probably scarce in the wild.

Counts. DR ii9; AR v18-24; PR 14-19; VR 8; 140-175 scales in the lateral line; 30-37 scales from lateral line to origin of dorsal fin, 17-22 from lateral line to origin of anal fin; GR 30-39.

Figure 65. Apure drainage distribution of *Acestrorhynchus falcirostris*.



CUENCA DEL RIO APURE

Pigmentation. The body is silvery in life, tan in alcohol, and darker dorsally. Fin membranes are hyaline or clear but the rays of the dorsal fin (especially the first three), caudal fin and anal fin are gray to black. The base of the caudal fin has a small, nearly round black blotch that extends onto the caudal peduncle. The opercle is edged with black posteriorly and may also have two dark concentrations of pigment, the upper separated from the lower by a narrow light stripe (Menézes 1969b).

Distribution and Natural History

Range. This species is known from the Brazilian Amazon, the Orinoco Basin in Venezuela, and Guyana (Menézes 1969b).

Apure distribution. Map: fig. 65. *A. falcirostris* is known only from one site in a blackwater river of the Aguaro River system in the southeastern corner of the drainage.

Habitat. This species was found in a nearly transparent tea-colored stream of the low llanos of Guárico state, an area characterized by sandy soils and sparse savanna vegetation.

Abundance. RARE. Known only from one specimen.

Number of specimens examined. 1.

Food. CARNIVORE. This species is mostly piscivorous.

Reproduction. Strategy: Probably r2.

Acestrorhynchus sp. ("pico largo")

Care'perro, Picúa - Pike Characin

No Figure. Map: fig. 66. Couplet 52a.

Comments. The number of lateral-line scales apparently increases with overall size in *A. microlepis*. If the same is true for *A. falcirostris* (which has a LLS count 140-175) then these specimens may

simply represent juveniles of that species. However, the only specimen of A. falcirostris collected was taken from similar blackwater habitat in Guárico state. Since the collecting effort at the site where these small specimens were found was extensive (monthly for one year plus several subsequent visits), and no adults of A. falcirostris were ever captured, their exact identification remains uncertain.

Description

Diagnosis. This species is very similar to juvenile A. microlepis but has a longer snout.

Size. Only small specimens up to about 50 mm SL were collected.

Counts. Lateral-line scales: 99-124.

Measurements. The snout is longer than in A. microlepis for specimens of comparable size, hence the "pico largo" designation, which means "long snout" in Spanish.

Pigmentation. The body is tan in preservative, with a black spot near the base of the caudal fin, similar to that in A. microlepis or A. falcirostris.

Distribution and Natural History

Apure distribution. Map: fig. 66. This species is known only from one site, Caicara Creek, in northern Apure state.

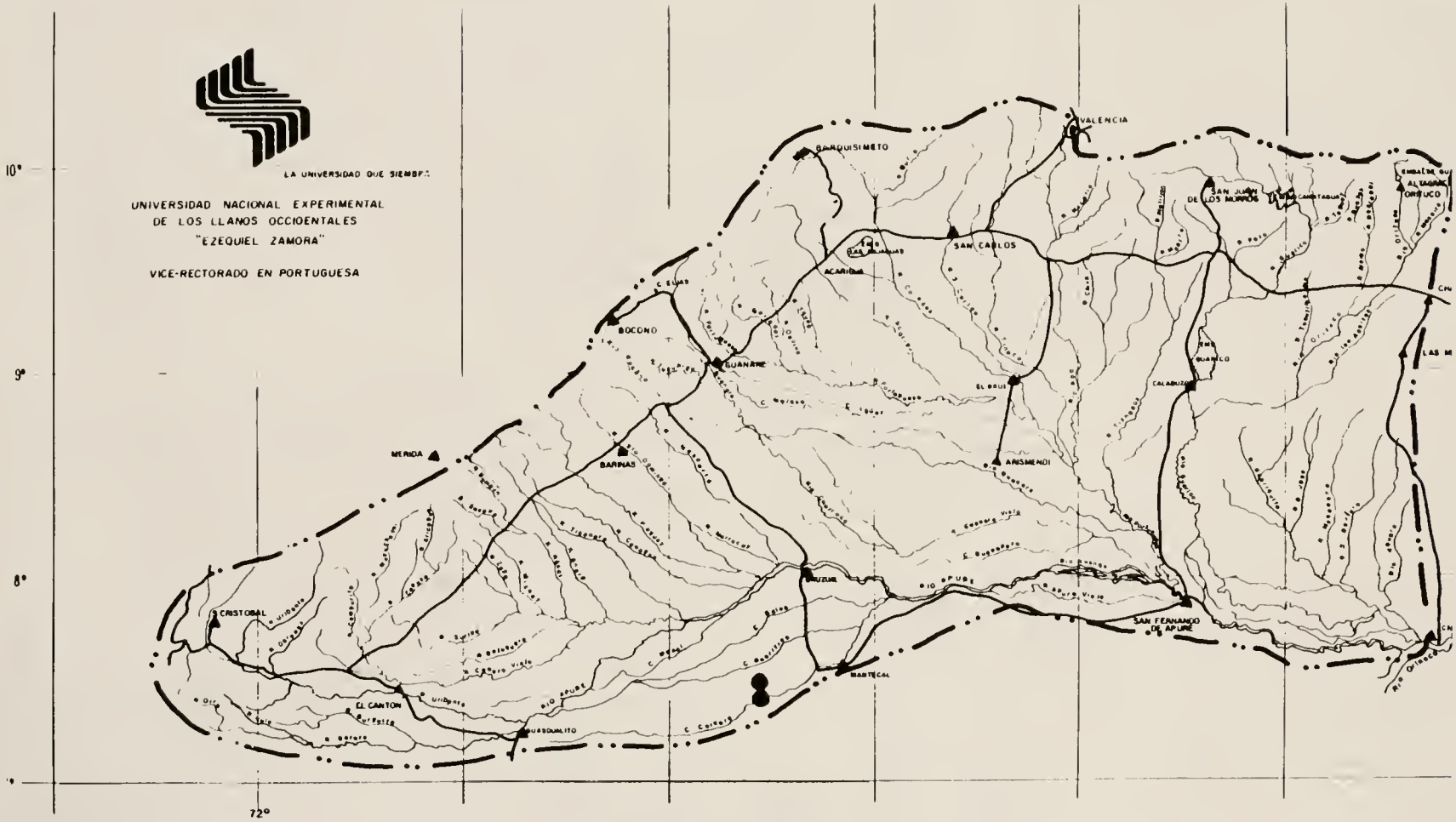
Habitat. It occurs in blackwater creeks of low llanos.

Abundance. RARE. It is known only from two collections at the same site.

Number of specimens examined. 37 from 2 collections.

Food. CARNIVORE. Presumably this species is almost exclusively piscivorous, as is true of related species.

Figure 66. Apure drainage distribution of Acestrorhynchus sp. "pico largo".



CUENCA DEL RIO APURE

Reproduction. Probably r2. The juveniles collected were taken in June and July, suggesting that breeding occurs during the early wet season, or perhaps just prior to it.

Acestrorhynchus microlepis (Schomburgk) 1841

Care'perro - Pike Characin

Fig. 67. Map: fig. 68. Couplet 52a.

Specific synonymy

Xiphorhamphus microlepis Schomburgk, 1841:247 (not plate 25; type locality: Essequibo River), seen.

Xiphorhynchus microlepis Cuvier & Valenciennes 1849:342 (Guyana).

Acestrorhynchus microlepis Eigenmann 1910:447; 1912:408 (part from Guyana); Eigenmann & Allen 1942:276 (synonymy); Fernández Y. 1955:4; Menézes 1969a:219 1969:62 (diagnosis, redescription, distribution, synonymy); Mago L. 1970:69; Géry 1977:330 (key); Menézes & Géry 1983:590 (key); Nico & Taphorn 1986:794 (diet).

Acestrorhynchus cachorro Fowler 1939:274 (type locality: Rio Ucayali drainage, Boca Chica, Peru).

Xiphorhynchus falcatus (not of Bloch 1794:120); Cuvier & Valenciennes 1849:337 (part, Mana?).

Acestrorhynchus falcatus Roman 1985:163 (Venez.).

Comments. This species apparently grades into A. guianensis, a form said to be present in easternmost Venezuela and Guyana, and it is probable the two are distinct only at the subspecific level. Alternatively, the two could be nearly identical sister-species, sympatric throughout their range (see above).

The holotype of A. guianensis (FMNH 74353) has jaws of approximately equal length. The first canine tooth of the upper jaw is larger than

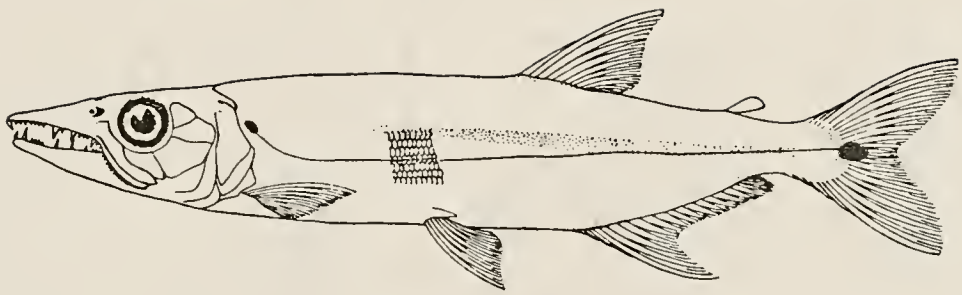


Figure 67. Acestrorhynchus microlepis. From Menézes (1969).

second. The caudal spot is triangular, and although no humeral spot is evident, there are a few chromatophores behind the opercle. The lateral-line canals have lateral branches, contrary to what was indicated in Géry's (1977) key.

Etymology. MICRO = small, LEPIS = scales.

Description

Illustrations. Fig. 67; Menézes 1969b:67, fig.50; Géry 1977:317. Román 1985:163, (misidentified as A. falcatus).

Diagnosis. This species is distinguished from A. falcatus by the absence of a large humeral blotch. It has fewer lateral-line scales (108-122) than the very similar A. falcirostris but more than A. minimus (74-85). Menézes (1969b) gave a complete diagnosis.

Size. A. microlepis grows to about 250 mm SL.

Morphology. This is a long slender, nearly cylindrical fish, with elongate well toothed jaws.

Counts. DR ii9; AR v25-31; PR 13-18; PR 8; 108-122 pored scales in the lateral line; 20-22 scales from lateral line to origin of dorsal fin, 15-18 from lateral line to origin of anal. The lateral-line scale count seems to increase with the size of the specimen, small ones around 100-115, larger ones with up to 140. This character is quite variable. Since it is quite unusual for the number of lateral-line scales to vary with size, it is possible that there are two sympatric species present, a smaller one with fewer scales and a larger one with more scales. If this is the case, they are nearly identical. Gillrakers 20-26 on lower half of the outer arch.

Pigmentation. This fish is silvery in life, (tan in alcohol), with the dorsum darker than the ventrum. There is a small, rounded, distinct black spot at the base of the central caudal-fin rays. The humeral spot is

usually absent, or there may be a very small indistinct dark blotch at the origin of the lateral line, behind the opercle.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins, as well as in Guyana, Surinam and French Guiana (Menézes 1969b).

Apure distribution. Map: fig. 68. This species was most frequently collected from northern Apure state, the Aguaro River system in the southeasternmost part of the drainage, and in Barinas in the Suripá drainage.

Habitat. It is found most commonly in northern Apure state, in blackwater creeks, and prestamos of the module system, and in the tributaries of the Aguaro River system in the sandy-soiled savannas where morichales are common. This species seems to prefer slow-moving streams with abundant aquatic vegetation.

Abundance. COMMON, but it is found only in isolated populations where conditions are favorable.

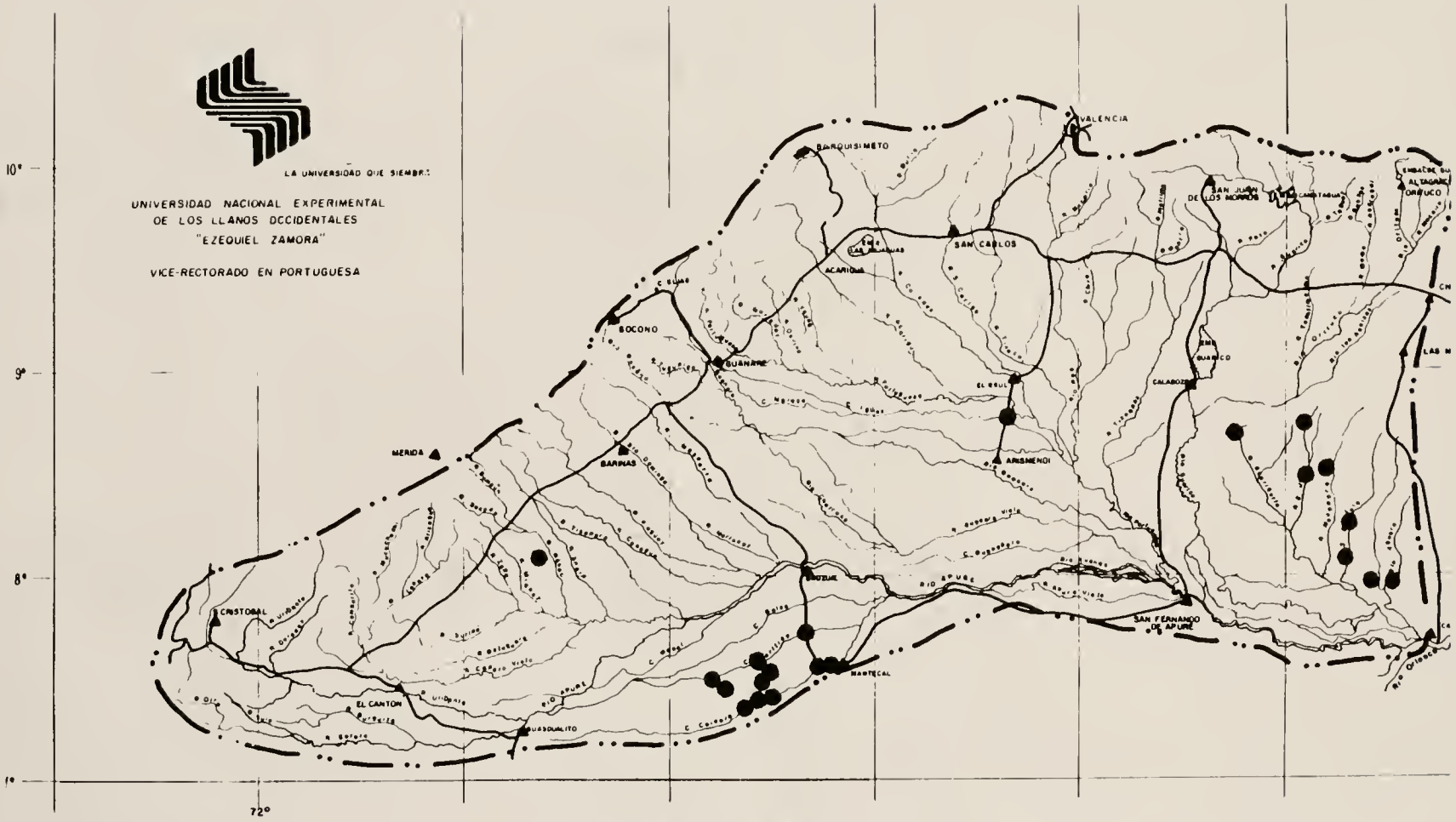
Number of specimens examined. 334 in 46 collections.

Food. CARNIVORE. This species is piscivorous in all but the smallest juvenile stages, when aquatic invertebrates are taken (Nico & Taphorn 1985).

Reproduction. Probable strategy r1. Small juveniles have been collected in October, which is the end of the rainy season. This probably is an indication that this species spawns more than once during the wet season.

Importance. Although A. microlepis has no commercial importance as a food fish, it is sometimes collected as an ornamental. A notorious piscivore, this species should be housed by itself in aquaria.

Figure 68. Apure drainage distribution of *Acestrorhynchus microlepis*.



CUENCA DEL RIO APURE

Aphyocharax alburnus (Günther) 1869

Sardinita Coliroja - Bloodfin Tetra

Fig. 69. Map: fig. 70. Couplet 62a

Generic synonymy

Aphyocharax Günther 1868b:245, 254 (type species: A. pusillus Günther 1868); Eigenmann 1910:429; 1912:312; 1919:22; Eigenmann & Allen 1942:265.

Specific synonymy

Chirodon alburnus Günther 1868:424 fig. 2 (type locality: Rio Marañon [Peruvian Amazon Basin]), not seen.

Aphiocharax (error) alburnus Eigenmann & Eigenmann 1891:55.

Aphyocarax (error) alburnus Ulrey 1895:292.

?Aphiocarax (error) (Chirodon) alburnus Perugia 1897:25 (Rio Beni).

Aphyocharax alburnus Eigenmann 1910:429; 1915b:27 (Brazil, Bolivia), 1919:27; Román 1985:166 (Venez.).

Aphyocharax avary Fowler 1913b:532 fig.8 (type locality: Rio Madeira).

Comments. The distinctions between this species and A. erythrurus are slight, and they may be synonyms. Both have been cited for the Orinoco Basin (Fowler 1943 [Florencia, Colombia] & Schultz 1944b [Caripito, Venez.]). The Apure specimens have melanophores along the central caudal rays, a feature stated to be diagnostic by Eigenmann (1919) since the central caudal rays of A. erythrurus are said to be pale. They also have 15-18 teeth on the maxilla, so in these two characters they agree better with the descriptions of A. alburnus. Since A. alburnus is the older name, it would have priority if they are synonyms. However, I have not observed the "golden crown" coloration mentioned as characteristic of A. alburnus by Axelrod et al. (1971), so doubt remains. The holotype (FMNH 53579) of

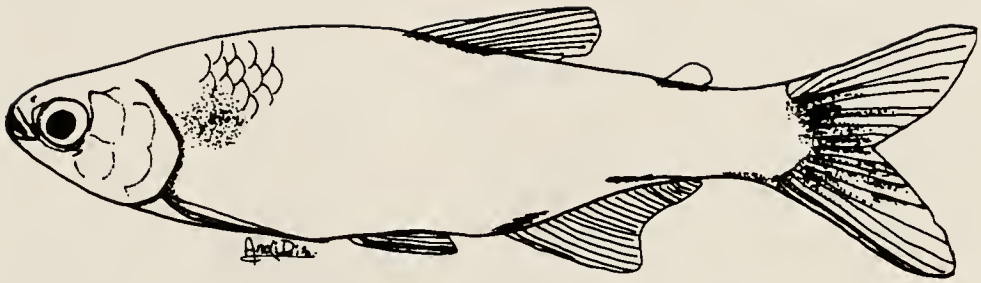


Figure 69. Aphyocharax alburnus.

A. erythrurus has no humeral spot nor any dark pigment remaining, and in general appears to be more slender than the Apure specimens, with an apparently longer head and caudal peduncle and a larger eye; the LL is incomplete with about 11 pored scales, the base of the caudal fin is scaled, and the maxilla is very large and wide.

Etymology. APHYO = small, CHARAX = palisade of pointed sticks, from the Greek (Eigenmann 1919), in this case referring to a palisade of pointed teeth, but also given to mean a "gnasher of teeth" in some of Eigenmann's other works, Charax is a characid genus frequently used in the formation of generic names; ALBURNUS = whitish, from the Latin "albus," perhaps referring to the whitish fin tips, or the generally light colored body.

Description

Illustrations. Fig. 69; Fowler 1948:171 fig. 196; Román 1985:166; as A. erythrurus: Axelrod et al. 1971:F-48.10; Géry 1977:349.

Diagnosis. There is only one species of Aphyocharax known from the Apure drainage. Characteristic features of this species include: a single row of conical teeth on the premaxilla; a toothed maxilla; an incomplete lateral line and a brick-red caudal fin.

Size. A. alburnus can grow to about 50 mm SL, but most individuals are usually between 20-40 mm. A 28 mm specimen SL weighed 4 grams.

Morphology. This is an elongate, cylindrical species (GBD is about 26% SL) with the dorsal fin well in advance of the anal fin, the pelvic fins are in advance of dorsal; an adipose fin is present; the caudal fin has somewhat rounded lobes. The snout is rounded and short, its length is less than the eye diameter. The lateral line is incomplete, with 10-11 pored scales. The base of the caudal fin is densely scaled. Males have hooks on the pelvic and anal fins.

Counts. DR ii8-ii9; AR ii15-iii18; PR i9; VR i7, GR 10; LS 35-39 (with 10-11 pored scales in the lateral line reaching to just over the pelvic insertions); TS 10; CPS 14. The premaxilla has 7-8 teeth on either side in a single row. The maxilla has up to about 20 teeth, but is not completely toothed, and does not reach the large suborbital posteriorly.

Pigmentation. The body is bluish-silvery to olive-tan, with the caudal fin bright to brick red, and the anal fin with the first few rays whitish. All fins may have some reddish tint. The body is tan in preservative with all the fins clear (the red is usually lost). A diffuse humeral spot is usually present. The peritoneum is gray.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 70. This species is ubiquitous in the llanos and Andean piedmont.

Habitat. This species survives in a wide variety of habitats in the lowlands and Andean foothills, from major river channels to stagnant ponds, and in all types of water, white, black and clear. It usually is found in large schools, near the edges of stands of aquatic vegetation.

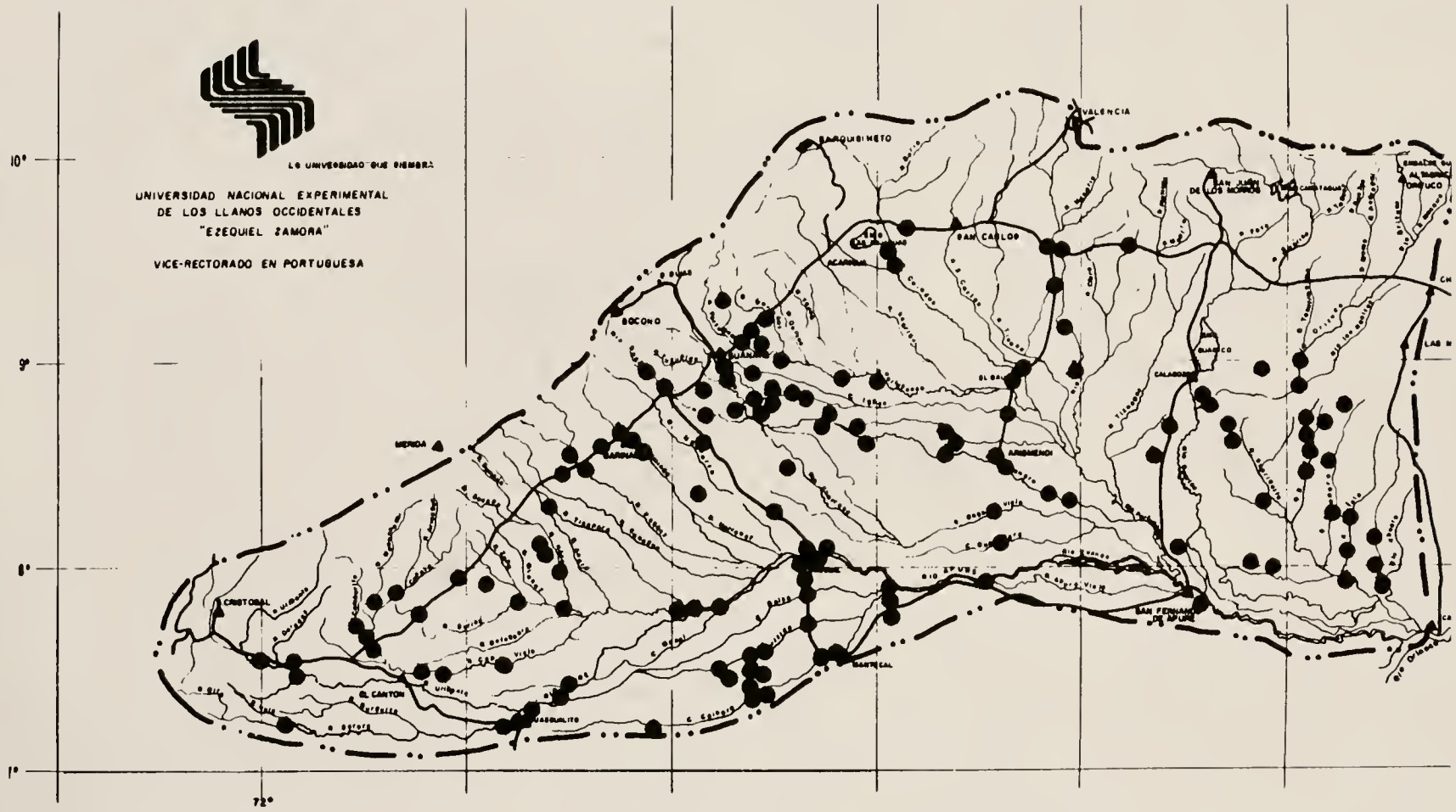
Abundance. ABUNDANT.

Number of specimens examined. 6,992 from 323 collections.

Food. OMNIVORE. It feeds on aquatic and terrestrial insects, microcrustaceans and other small invertebrates, as well as some vegetable matter.

Reproduction. Strategy: r1; fecundity: 617 eggs/female; egg diameter: 0.65 mm. Breeding mainly occurs during the first three months of the wet season, but perhaps continues throughout its duration. Individuals can

Figure 70. Apure drainage distribution of *Aphyocharax alburnus*.


LO UNIVERSIDAD QUE SIEMBRA
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
7°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
MERIDA
CRISTOBAL
EL CANTON
GUASDUALITO
BARINAS
ARAUCA
RIO APURE
SAN FERNANDO DE APURE
SAN JUAN DE LOS MORROS
CALABOZO
CARITAGUA
ORITUCO
LAS
CUENCA DEL RIO APURE
100
200
ESCALA GRAFICA

breed more than once a year. Generation time is about 11-12 months (Winemiller & Taphorn 1989). Hoedeman (1975) reported on the breeding behavior of a similar species, A. rubripinnis, in which mating takes place when mature fish move into the shallows, and eggs and sperm are released over aquatic vegetation in mass spawning bouts. The parents may eat the embryos. After hatching, the embryos absorb the yolk sac for 3-4 days before beginning active foraging for plankton.

Importance. Ornamental.

Astyanax bimaculatus (Linnaeus) 1758

Sardina Dos Puntos - Two-spotted Astyanax

Fig. 71. Map: fig. 72. Couplet 96a.

Generic synonymy

Astyanax Baird & Girard 1854:26 (type species: Astyanax argenteus, by monotypy); Fowler 1948:35.

Poecilurichthys Gill 1858:414,417 (type species: Poecilurichthys brevoortii Girard, by subsequent designation of Jordan 1919:281).

Zygogaster Eigenmann 1913:23 (type species: Zygogaster filiferus Eigenmann, by original designation).

Specific synonymy

Salmo bimaculatus Linnaeus 1758: 311 (type locality: "in America meridionali"), seen.

Tetragonopterus maculatus Müller & Troschel 1845:14, pl.3, fig. 4 (type locality: Brazil, Guiana, Surinam); Peters 1877:472 (Calabozo, Venez.); Pellegrin 1899:157 (Apure River, Venez.); Regan 1906:384 (Venez.).

Charax bimaculatus Gray 1854:154 (Surinam).

Astyanax bimaculatus Eigenmann 1920:11 (near Maracay and Valencia,

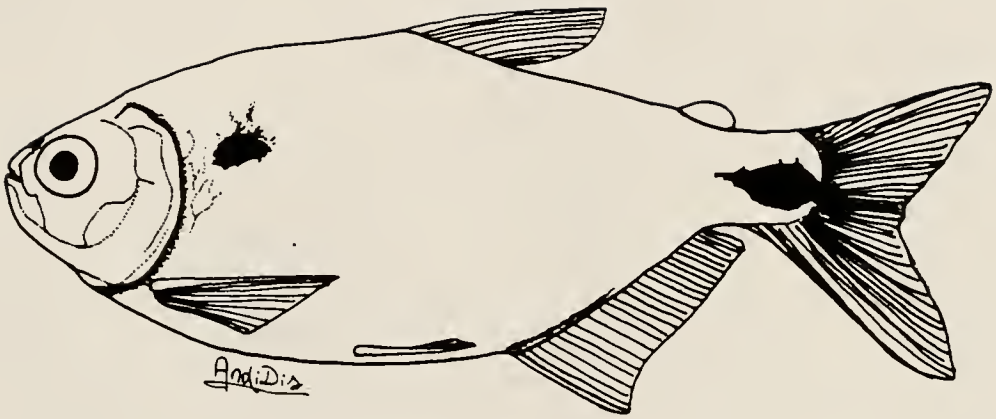


Figure 71. Astyanax bimaculatus

Venez.); Pearse 1920:19 (Valencia area, Venez.); Fowler 1931:408 (Guanoco area, Venez.); 1948:38 (synonymy, subspecies, Brazil); Schultz 1944b:355 (Río Guárico and tributaries, Caripito, Venez., key, synonymy); Mago L. 1970:69.

Comments. Detailed analysis of regional variations will probably reveal a complex of species and subspecies that are currently all lumped.

Etymology. ASTYANAX was a Greek mythological figure, the son of Hector. This genus was so named because of the large silvery scales' resemblance to armor (Innes 1966); BI = two; MACULATUS = spotted.

Description

Illustrations. fig. 71; Géry 1977:412, 413, 419; Hoedeman 1975:638; Román 1985:171; Axelrod et al. 1971:F-92.00.

Diagnosis. This species is distinguished from the other Astyanax present in the Apure drainage in having: the predorsal midline partially to completely scaleless; a dark black, horizontally ovate humeral spot; a dark black, horizontally ovate caudal spot at the base of the central caudal-fin rays that can extend onto the caudal peduncle; and 35-42 lateral-line scales. The sides lack dark wavy lines, and there is no oblique black stripe from the base of the anal fin onto the tail.

Size. Although literature reports claim it can reach nearly 160 mm TL, Apure drainage specimens reach a maximum of about 90 mm SL, and most individuals are only 50-60 mm.

Morphology. This is a robust, deep-bodied Astyanax. The lateral line is complete. The mid-dorsal line in front of dorsal fin is at least partly naked, but there are often a few scales present near

dorsal fin. The dorsal-fin length is about equal to head length; the anal margin is straight in adults, but emarginate in young. The swim bladder is two-chambered, the posterior chamber nearly twice as long as the anterior.

Counts. DR ii9; AR 29-35; PR i11-i13; LLS 35-42; scales above LL: 7-9; scales below LL: 6-7; 9 upper and 14 lower rakers on first gill arch; premaxillary teeth 4-4 in the outer row, and 5-5 in the inner; principal dentary teeth 4-4; no maxillary teeth.

Pigmentation. The body is silvery to bronze, with the back sometimes olive-green to greenish-bronze. There is a dark rounded humeral spot behind the upper part of the opercle, over the third to sixth or the second to fifth scale of the lateral line (Eigenmann 1912), and sometimes accompanied by a ventrally projecting vertical streak (Schultz 1944b). There is another dark black streak on caudal peduncle. A blackish lateral stripe usually unites these two spots. In life the smaller, more slender male sometimes has red or yellowish areas in the dorsal and caudal fins. The peritoneum is black.

Distribution and Natural History

Range. Various subspecies have been described from Panama in the north to the La Plata drainage in southern South America.

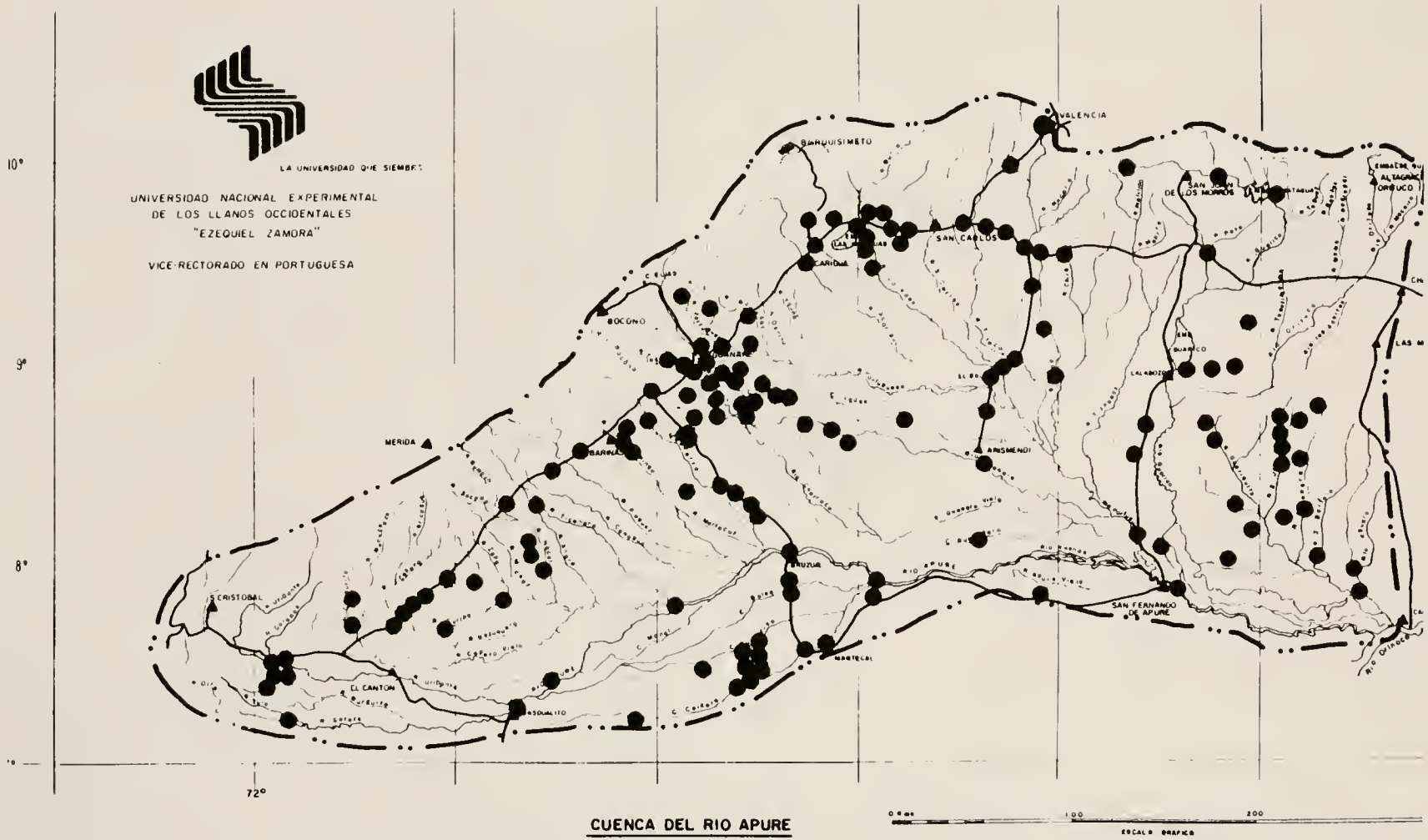
Apure distribution. Map: fig. 72. This species is well distributed throughout the drainage with the exception of the highest mountain streams.

Habitat. *Astyanax bimaculatus* is found in almost all biotopes, but is more common in flowing water.

Abundance. ABUNDANT.

Number of specimens examined. 6,704 from 319 collections.

Figure 72. Apure drainage distribution of *Astyanax bimaculatus*.



CUENCA DEL RIO APURE

Food. OMNIVORE. Aquatic plants, small seeds, flowers and various aquatic and terrestrial insects, spiders, and filamentous algae comprise the diet of this species (K. Winemiller pers. com., and original data). Pearse (1920) reported that in Lake Valencia *A. bimaculatus* feeds on a wide variety of foods including: algae (27), plants (25), insects (18), fish (11), chironomid pupae (3.9), cladocera (1.8), Diptera (1.5), Sialis larvae (0.5), insect larvae (0.3), Gasteropoda (0.2), unidentified (5.9); the numbers reflect per cent volume for 17 fishes examined.

Reproduction. Strategy: r2; generation time: about 12 months; fecundity: 4287 eggs/female; egg diameter: 0.90 mm (Winemiller & Taphorn 1989). This species breeds annually during the first 2 months of the wet season. In captivity it is easily spawned, but parents must be provided with a good diet. They scatter eggs over aquatic plants and then abandon them. Hatching occurs within 24-36 hours: after 5 days the yolk-sac is absorbed and the fry become free swimming and ready to feed on plankton (Axelrod et al. 1971).

Vanzolini & Reboucas (1965), who studied growth rings in Brazilian populations of this species, found that up to four different annuli could be formed in a year, and that their specimens reached adult size (about 110 mm) in one year.

Importance. Ornamental.

Astyanax integer Myers 1930

Sardina Coliroja - Red Tailed Astyanax

Fig. 74. Map: fig. 74. Couplet 88a.

Specific synonymy

Astyanax integer Myers 1930:67 (type locality: Guaicaramo, Río Guavio in the Río Meta drainage, Colombia); Fowler 1943:238 (Villavicencio, Colombia), seen.

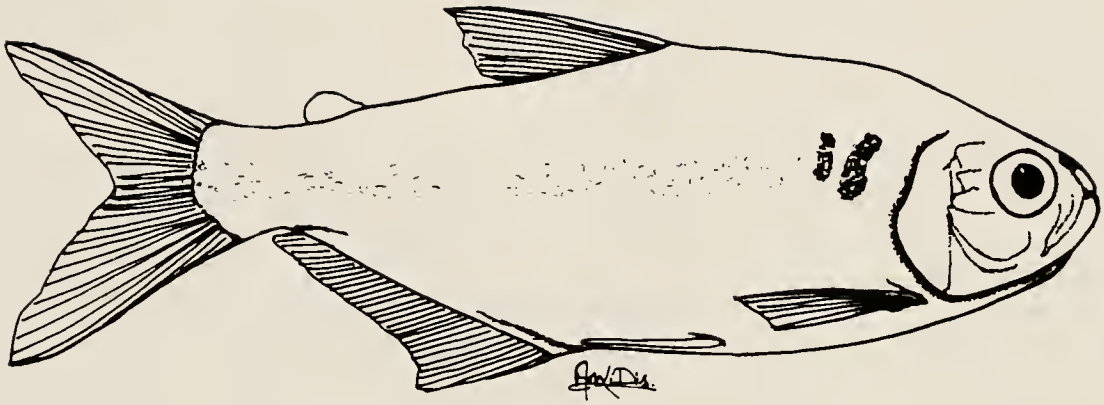


Figure 74. Astyanax integer.

Astyanax abramoides Schultz 1944b:355 (key, from Río Guárico and tribs.; synonymy).

Tetragonopterus abramis Pellegrin 1899:157 (Apure River, Venez.).

Types. Holotype: CAS-SU 23726.

Comments. Following Schultz (1944b), I had originally identified this species as A. abramoides a species described by Eigenmann from British Guiana, but I now believe it is closer to A. integer Myers. The holotype of A. abramoides (FMNH 52863) is a very deep-bodied fish, the depth in SL about 2.5, and it has an ovate humeral spot just behind the opercle on a level with the upper 1/2 of the eye. The caudal fin is marked with a basal blotch, and the middle caudal-fin rays show traces of pigment. The eye is quite large. There is no trace of a lateral stripe. The dorsal midline is not scaled. There are about seven short gill rakers on the upper limb of the outer gill arch, and about ten longer ones on the lower arch. The teeth are quite robust, with five tricuspid teeth on the outer premaxillary row, five pentacuspids on the inner row. Their rounded edges face in opposite directions.

Specimens from the Apure drainage differ greatly from the type material of A. abramoides. They have the dorsal midline scaled regularly, lack the caudal blotch, and in general fit the description of A. integer much better.

Etymology. INTEGER = complete, whole or unbroken, is from the Latin, and although no explanation was specifically indicated by the describer, I suspect that this refers to the complete scalation of the dorsal midline observed in this species, a character that is of subgeneric importance in these fishes.

Description

Illustrations. Fig. 74; Fowler 1943:236, fig. 17; Román 1985:173, as A. abramoides.

Diagnosis. When alive, this species is easily recognized by the bright red tail. It usually has more lateral-line scales (43-50, usually 46-50) than other Apure drainage Astyanax, although some overlap exists. A. polylepis sometimes has high lateral-line scale counts, but that species is characterized by stout pelvic spines that often project through the abdominal skin, a situation never observed in A. integer. It is easy to confuse this species with A. bimaculatus, but that species lacks maxillary teeth (one is present in A. integer, and has 43 or fewer lateral-line scales (vs 43-50).

Size. It is a fairly large Astyanax reaching at least 120 mm SL.

Morphology. See Myers (1930) for a complete description. His diagnosis is as follows: Astyanax with predorsal region completely and regularly scaled, lateral line about 50, anal 30, the central caudal rays black, a well defined humeral blotch, and a wide dark lateral band from behind humeral spot to caudal. Fowler (1943) described in detail two specimens from Villavicencio, Colombia.

Counts. DR ii8-ii9; AR iii26-iii31; PR 11-13; VR i7; LLS 43-50, usually 46-50; TS 18 (9-10 above LL, 7-8 below it). Premaxillary teeth 3-4 or 4-4 in outer row, 5-5 in inner. Maxillary with one tooth. Scales at base of caudal not covering more than 1/4 of the length longest rays. Gillrakers about seven on upper and 10-14 on lower limb of outer arch.

Measurements. GBD about 38% SL; HL about 28% SL.

Pigmentation. The body is silvery with a vertically elongate, often double humeral spot. In life the caudal fin is bright red, with

the central caudal rays sometimes blackish. The anterior anal rays have red along their shafts and black specks on the posterior membranes. There is sometimes red or yellow color in the dorsal fin and eye. A wide lateral stripe starts under the tip of the last dorsal ray and widens noticeably on the caudal peduncle; it is silvery in life, but dark in preservative. It is usually not continued to the tips of central caudal-fin rays. The adipose fin is speckled with pigment. The humeral spot extends ventrally, and is not usually horizontally ovate.

Distribution and Natural History

Range. It occurs in Andean tributaries of the Orinoco River.

Apure Distribution. Map: fig. 74. This species occurs in Andean montane and piedmont rivers and tributaries of the Guariquito River in the easternmost region of the drainage.

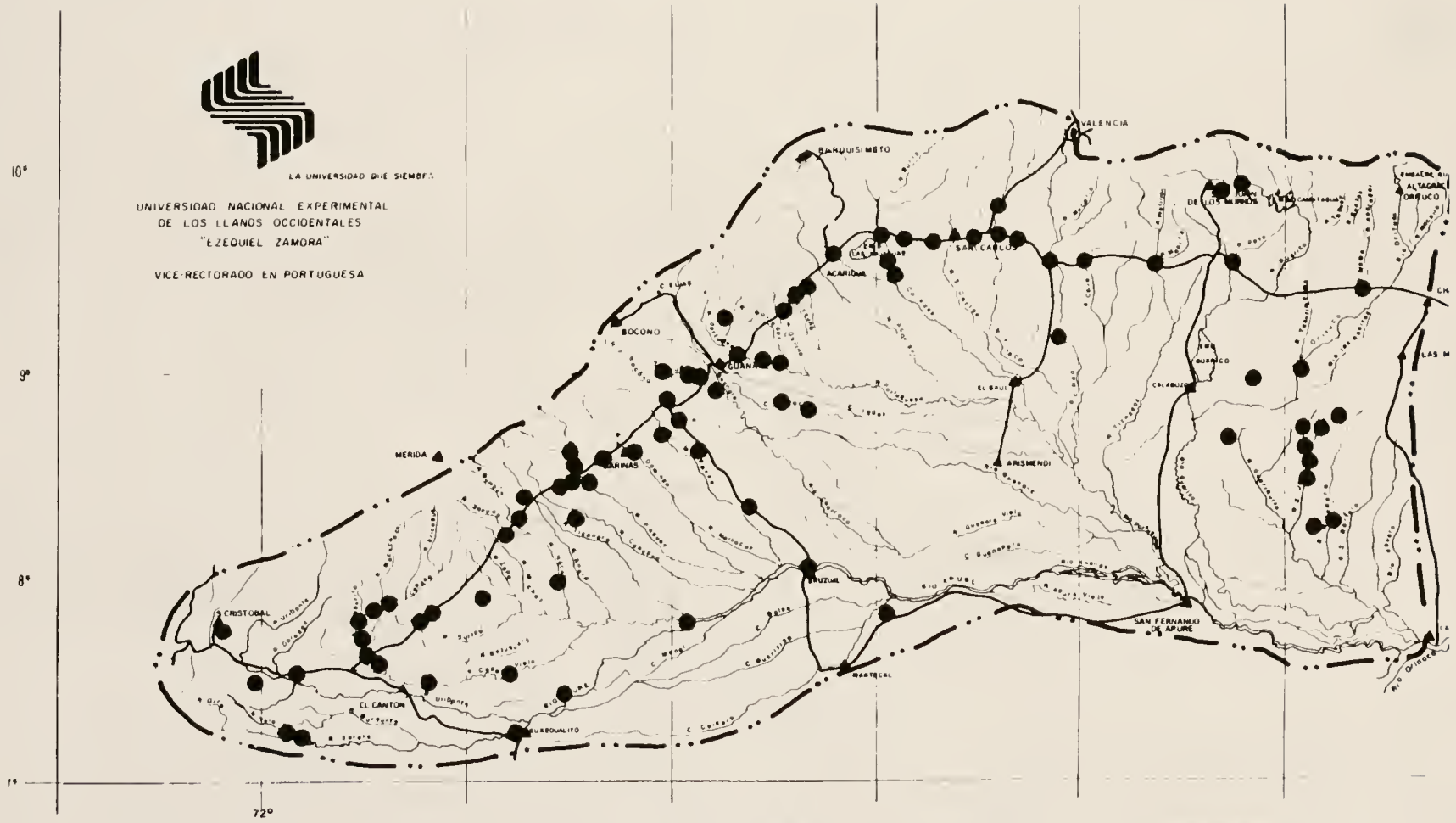
Habitat. This species is mostly restricted to piedmont and montane streams, though it has also been collected from the main channels of rivers in the low llanos, and from the upper reaches of the blackwater streams in open savanna. It is usually found in clear, clean, relatively undisturbed streams with moderate to fast currents, over rock, gravel or sand substrates. It is abundant in pools and the calmer parts of the rapids, and often takes refuge behind branches or boulders where it if often seen schooling.

Abundance. COMMON.

Number of specimens examined. 691 from 106 collections.

Food. OMNIVORE. Its diet includes small seeds, fruit and terrestrial insects (Winemiller, pers. com.). This species is a midwater feeder that picks food items from the debris carried downstream in the

Figure 74. Apure drainage distribution of *Astyanax integer*.



CUENCA DEL RIO APURE

current. It will eat all sorts of campsite leftovers (rice, spaghetti, fruit, bread, meat etc.), an indication that it is not too particular about its diet, scavenging whatever the current washes down.

Reproduction. Strategy: r2; generation time: 12 months; fecundity: 8400 eggs/female; egg diameter: 1.00 mm; oviparous; it spawns annually during the first two months of the wet season (Winemiller & Taphorn 1989).

Importance. Ornamental.

Astyanax metae Eigenmann 1914

Sardina - Astyanax

Figs. 56 & 75. Map: fig. 76. Couplet 89a.

Specific synonymy

Astyanax metae Eigenmann *in* Eigenmann, Henn & Wilson 1914:11 (type locality Río Negro, Villavicencio, Colombia), seen; Eigenmann 1920:11 (Maracay and Valencia area, Venez.); Pearse 1920:19,42 (Lake Valencia area, Venez.); Eigenmann 1922:235 (Lake Valencia area, Venez.) Schultz 1944b:358 (Río Guárico and tribs, and Caripito, Venez.); Mago L. 1970:69; Géry 1977:397; Román 1985:173.

Types. Holotype: FMNH 56640 (formerly CM 5457), (examined). Paratypes: CAS 39229 (4) (formerly IU 13153).

Etymology. METAE = for the Río Meta.

Description

Illustrations. Figs. 56 & 75; Géry 1977:397; Román 1985:173.

Diagnosis. The oblique band of black pigment that runs along the base of the anal fin into the upper lobe of the caudal fin is characteristic of this species.

Size. This is a large *Astyanax* reaching over 160 mm TL, but usually seen between 80-100 mm TL.

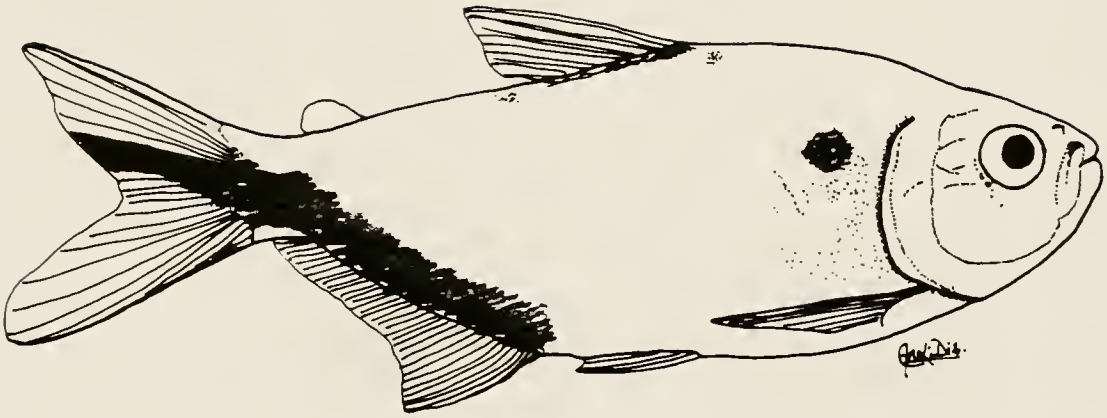


Figure 75. Astyanax metae.

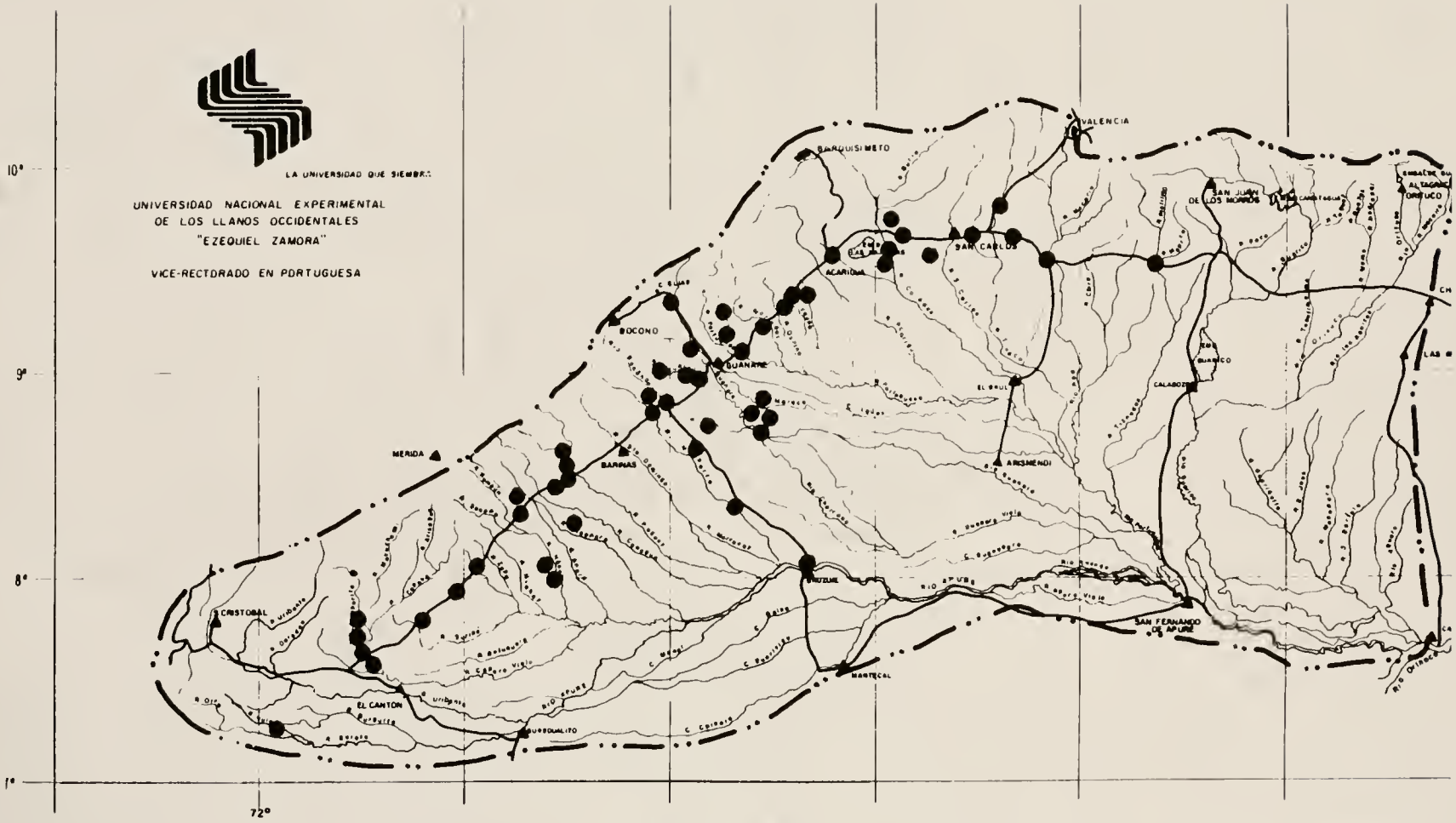
Morphology. A. metae is a large, robust Astyanax with a moderately compressed body that is rather heavy anteriorly and which has the preventral area rounded. The predorsal midline is completely scaled, with a series of 10-11 scales. The lateral line is complete. The dorsal-fin origin is about an eye diameter closer to the snout tip than to the midcaudal base, or equidistant between them (Schultz 1944b). The occipital process extends about one-fourth of the distance to the dorsal fin origin, and is bordered by four scales on each side. The maxilla is slightly longer than the eye diameter. The anal and caudal-fin bases are sheathed with scales. The teeth are massive, and number four in the outer and five in the inner row on each side of the premaxilla. There are four large teeth plus 3-6 tiny teeth on either side of the dentary.

Counts. DR ii9; AR 27-33; PR i11-i14; LLS 39-42; TS above LL 9-10, below LL 6-7; GR 14-17; premaxilla with 4-5 teeth in outer and 5 in inner row; maxilla with 1 or 2 teeth; GR 12 on upper and 15 on lower limb of outer arch.

Measurements. GBD 2-2.6 in large adults, 2.9 in young; HL about 29% SL in adults.

Pigmentation. The body is silvery, the fins clear. An oblique black band extends posteriorly from the base of the anal fin up onto the caudal peduncle and thence onto the upper middle caudal-fin rays. The black pigment is distributed asymmetrically. It is most intense on the four central rays of the upper caudal-fin lobe, with practically no black pigment on the (opposite) central rays of the lower caudal-fin lobe. This oblique stripe is sometimes lost in largest specimens, or those long preserved. The humeral spot is absent or represented by an oblique streak, with a pale area behind it (Eigenmann 1914, Schultz

Figure 76. Apure drainage distribution of *Astyanax metae*.



CUENCA DEL RIO APURE

1944b). The holotype still shows the characteristic black streak along the anal base and into the tail, with the caudal rays above center the darkest, and black to their tips.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 76. This species is limited to the highlands.

Habitat. Mountain streams with clean water swift currents, and rocky substrates are the favorite haunts of this species. It often forms mixed schools with A. integer, Hemibrycon metae and other characids the congregate below riffles and behind submerged branches.

Abundance. COMMON.

Number of specimens examined. 1,002 from 70 collections.

Food. OMNIVORE. These fish feed on items washed down in the swift current such as small seeds, fruit, terrestrial insects (Winemiller pers. com.). Pearse (1920) reported a diet in Lake Valencia consisting of 45% (by volume) mayfly nymphs, plants (46%), and seeds (6%).

Reproduction. Strategy: r2; generation time: 12 months; fecundity: 9528 eggs/female; egg diameter: 1.00 mm; it spawns annually during the first month of the rainy season (Winemiller & Taphorn 1989).

Astyanax polylepis (Günther) 1864

Sardina - Astyanax

Fig. 77. Map: fig. 78. Couplet 86a.

Specific synonymy

Tetragonopterus maculatus Müller & Troschel 1845:74 (part).

Tetragonopterus polylepis Günther 1864:320 (type locality: Guyana), seen.

Poecilurichthys polylepis Eigenmann 1910:433; 1912:356.

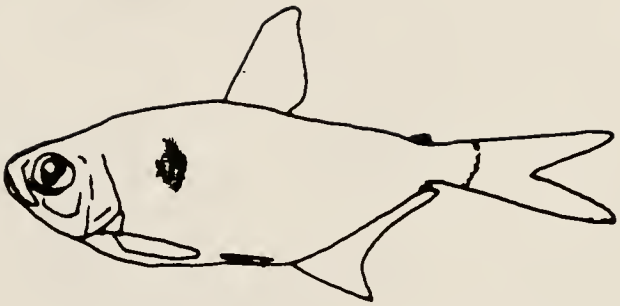


Figure 77. Astyanax polylepis.

Etymology. POLY = many; LEPIS = scales.

Description

Illustrations. Fig. 77; Eigenmann 1912:pl. 52.

Diagnosis. The circular spot set farther back on the sides (over the seventh to the ninth scales of the LL) distinguishes this species from other Apure drainage *Astyanax* species. The black spot is surrounded by a pale area, and may have vertical extensions. Spines that extend out from the pelvic bones (and at least in preserved material, pierce the skin of the abdomen) are another feature unique to this species among Apure drainage *Astyanax*.

Size. Normally *A. polylepis* is found between 40-50 mm SL, but it reportedly reaches 90 mm (Eigenmann 1912).

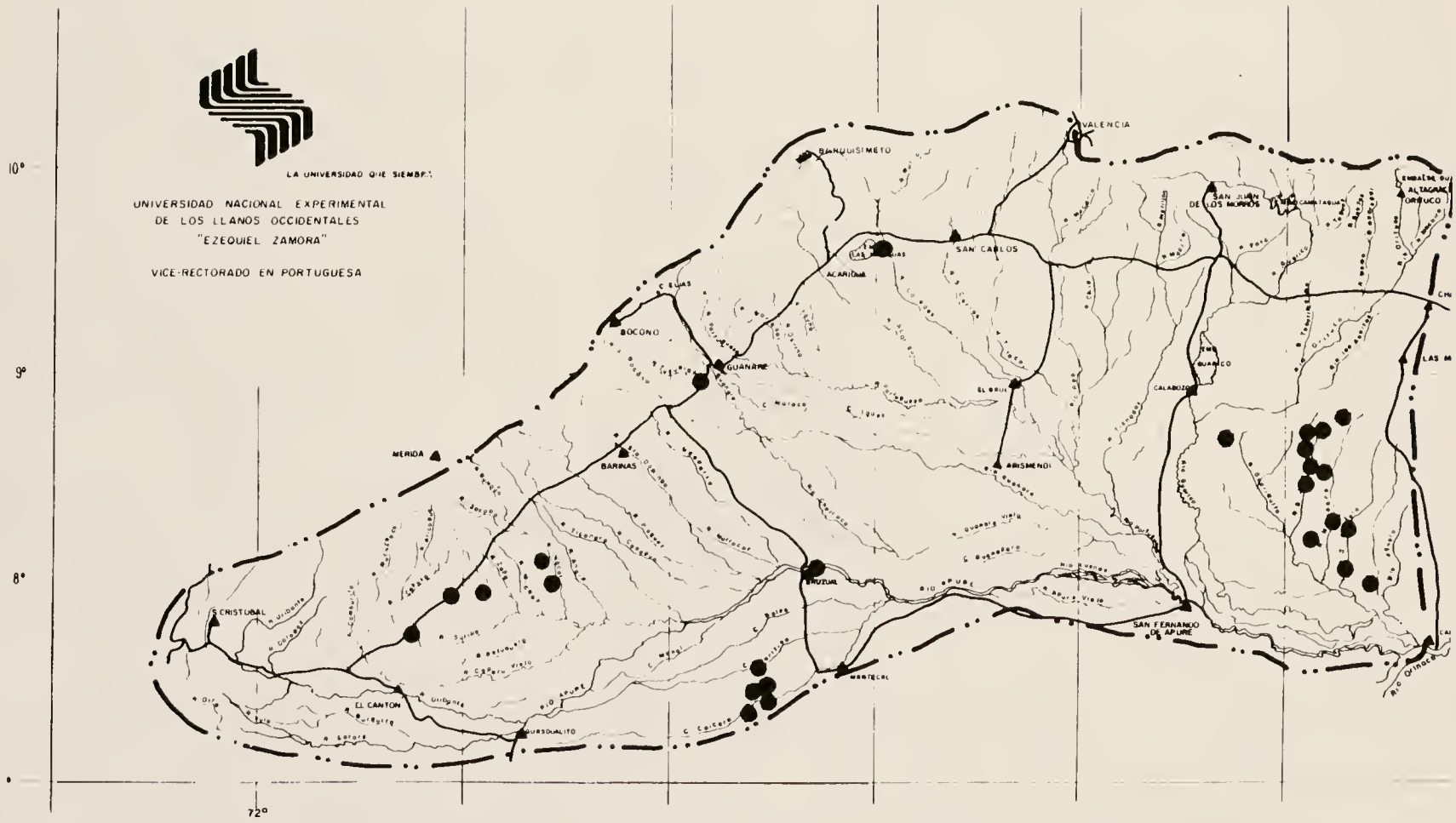
Morphology. The body is much compressed and elevated, more than in any other Apure drainage *Astyanax*. There are 3-4 scales on the dorsal midline just in front of the dorsal-fin origin, but anteriorly it is naked. A sheath of scales is present anteriorly on the anal fin and the base of the caudal fin is also scaled.

Counts. DR ii9; AR iii23-iii26; PR i11-i12; VR i7; LLS 38-46; TS 9-10 above, 7-8 below LL. The premaxillary teeth number four in the outer row, five in the inner, and the maxilla has two multicuspid teeth.

Measurements. GBD 36-41% SL; HL 27-32 % SL.

Pigmentation. The body is whitish in preservative, but heavily dotted with melanophores, especially along the lateral line area and the dorsal midline. The scales on the upper sides are outlined with gray and have white centers. Pigment in the dorsal fin follows right next to the rays. The anal fin has melanophores throughout the membrane and sometimes the first rays are tipped in white.

Figure 78. Apure drainage distribution of *Astyanax polylepis*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in Guyana and Venezuela.

Apure distribution. Map: 78. A. polylepis is most commonly taken from blackwater streams in northern Apure state, from the Aguaro River system in the southeasternmost part of the drainage, and in Barinas state, in the Suripá drainage.

Habitat. Blackwater streams and morichales are the most often frequented biotopes of this species.

Abundance. COMMON.

Number of specimens examined. 642 from 41 collections.

Food. OMNIVORE.

Reproduction. Strategy: Probably r2, as are the rest of the species of Astyanax. It probably scatters eggs over vegetation, and no parental care is expected. Males have tiny hooks on the anal fin rays presumably used to assist in maintaining close contact during the fertilization of the eggs.

Importance. Ornamental.

Astyanax superbus Myers 1942

Sardina - Superb Astyanax

Fig. 61. Map: fig. 79. Couplet 97a.

Specific synonymy

Astyanax superbus Myers 1942:92 fig.2 (type locality: a small brook tributary to Río Tamanaco [a trib. to Río Paye, Río Portuguesa system], at Camoruco, 20 km northeast of San Carlos, [state of Cojedes], Venezuela); Schultz 1944b:357 (key, Río Torbes near Táriba, Venez.); Mago L. 1970:69; Géry 1977:430,454 (key).

Comments. Dr. Barry Chernoff (pers. com.) believes this species might pertain to the genus Astyacinus.

Types. Holotype: CAS-SU 36489, Paratypes: CAS-SU 36490 (3).

Etymology. SUPERBUS = we cannot know what Myers considered to be "superb" in this fish, since the significance was not explained, but I suspect that it refers to the intricate color pattern of wavy lines, an unusual situation for this genus.

Description

Illustrations. Fig. 61 (in key) ; Myers 1942:92 fig. 2 (drawing of holotype).

Diagnosis. The dark wavy lines on the sides of this species are unique among Apure drainage Astyanax species. It also has a rather high number of maxillary teeth (six). The humeral spot is dark and horizontally ovate. A dark lateral stripe continues out through the central caudal-fin rays.

Size. It grows to 130 mm SL, but most individual are smaller (70-100 mm).

Morphology. The predorsal midline is irregularly scaled, but there is no naked area. A. superbus is a fairly typical Astyanax with a rounded belly, the postventral area sharper, and the predorsal area bluntly keeled. However, the body is not particularly compressed. The dorsal-fin origin is midway between the snout tip and the tip of appressed adipose fin. The origin of the anal fin is slightly posterior to the base of last dorsal ray, its border is nearly straight. The appressed pelvic fins reach slightly past the anus in males, but not quite to the anus in females. The pelvic fin insertions are just anterior to the dorsal fin origin. The pectoral fins reach the pelvic

fins in males but not in females. The anal fin has a sheath of one row of scales.

Counts. DR 10; AR 29-32; LLS 39-42; TS 7-8 above LL, 6-7 below it; GR-12 on lower limb of first arch; maxilla with 5-6 teeth.

Measurements. Head 4.1 - 4.6 in SL, depth 2.7; eye 3.3 in a small male to 4.1 in a large female.

Pigmentation. The body is dusky in general, darker dorsally, with all scales except those on the belly with a narrow dark border. The sides of the body have horizontal wavy lines between the scale rows. Males are darker and show a more complex pattern of wavy lines than females. A rounded or horizontally ovate humeral spot is present, but is not surrounded by a lighter area as in *A. polylepis*. The lateral stripe is not particularly dark except on the caudal peduncle, but the pigment continues through the central caudal rays out to their tips.

Distribution and Natural History

Range. It is known only from Venezuela, but is undoubtedly present in the Andean tributaries of the Orinoco of Colombia as well.

Apure distribution. Map: fig. 79. Restricted to montane and piedmont streams.

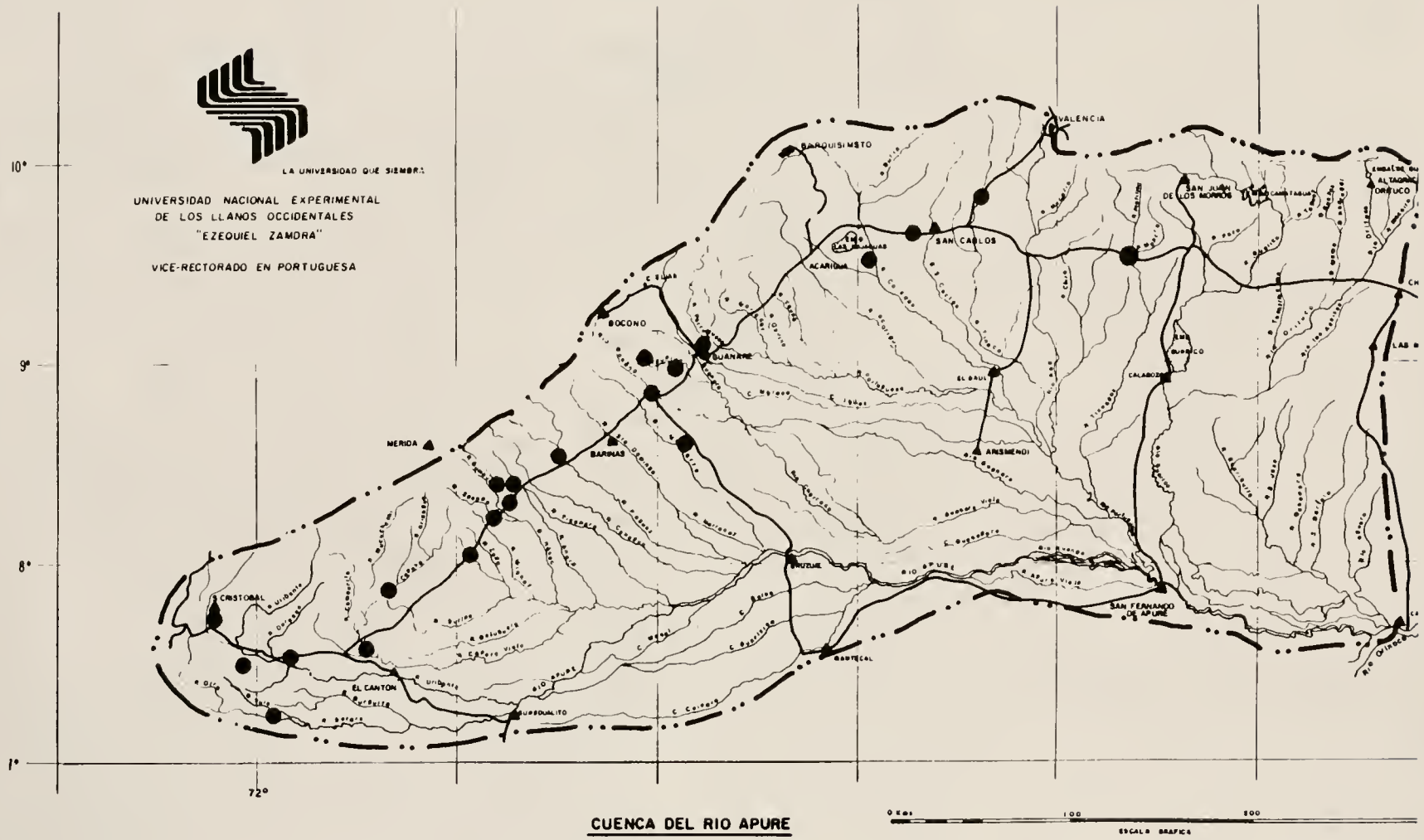
Habitat. Small, usually very shallow, shady streams in the Andes.

Abundance. UNCOMMON. This species may be more common that the number of collections would indicate, since it lives in the higher areas of the drainage, which are less accessible.

Number of specimens examined. 278 from 23 collections.

Food. OMNIVORE. It feeds on terrestrial insects and small seeds (K. Winemiller pers. com.)

Figure 79. Apure drainage distribution of *Astyanax superbus*.



CUENCA DEL RIO APURE

800 eggs/female; egg diameter: 0.65 mm; spawning occurs annually during the first month of the wet season. Individuals may spawn more than once (Winemiller & Taphorn 1989).

Importance. Though not currently sold as such, this species has potential as an ornamental.

Astyanax venezuelae Schultz 1944

Sardina - Venezuelan Astyanax

Fig. 80. Map: fig. 81. Couplet 97b.

Specific synonymy

Astyanax venezuelae Schultz 1944b:359 fig. 54 (type Locality: Río Torbes, 1 km above Táriba, Orinoco System, [Venezuela], seen); Mago L. 1970:69; Géry 1977:442.

Types. Holotype: USNM 121449; Paratypes: USNM 121450.

Etymology. VENEZUELAE = after the country where it was collected.

Description

Illustrations. Fig. 80; Schultz 1944b:360 fig.54.

Diagnosis. This species is similar to A. superbus but lacks the wavy lines on the sides characteristic of that species and has fewer (1-2) maxillary teeth. The predorsal midline is scaled. It differs from A. fasciatus in having the dorsal-fin origin much farther forward.

Size. It grows to a maximum of about 120 mm SL, but most individuals are smaller (70-100 mm SL).

Morphology. It is a stout, somewhat compressed Astyanax.

Counts. DR ii9; AR 26-29; PR i13-i14; LLS 40-41; TS 8-9 above, 6-7 below LL; GR1 5-16; outer premaxillary row with 4-5 teeth, inner with five; maxilla with one tooth; all teeth tri- to pentacuspid with the central cusp longest.

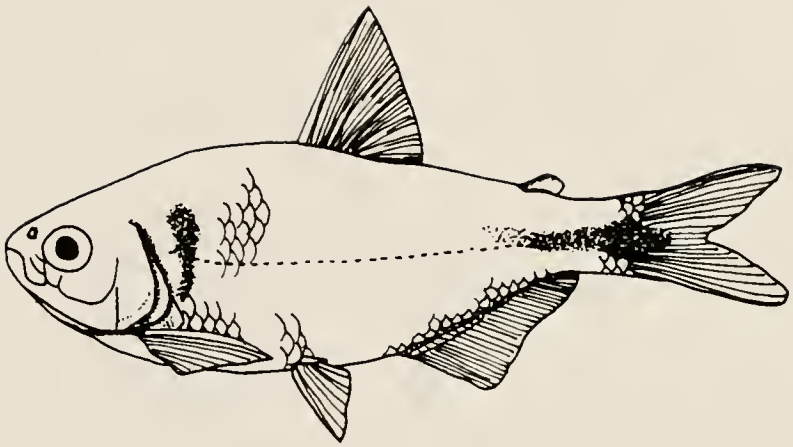
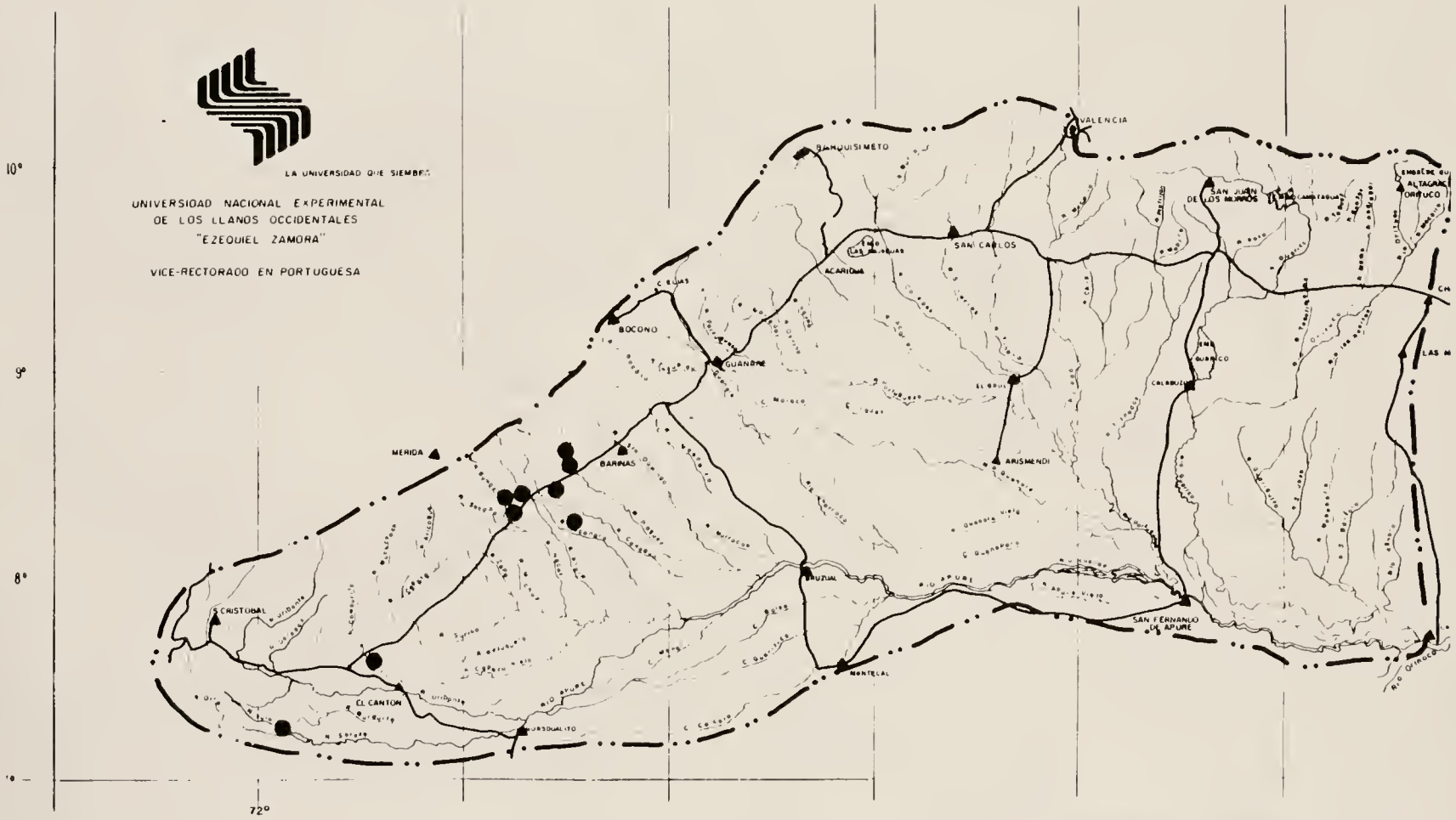


Figure 80. Astyanax venezuelae.

Figure 81. Apure drainage distribution of *Astyanax venezuelae*.



CUENCA DEL RIO APURE

Measurements. HL 26-27 % SL; GBD 36-37% SL.

Pigmentation. The humeral bar is distinct and vertically elongate, with pale areas in front and behind. The lateral stripe is faint, but intensifies on the caudal peduncle and continues to the tips of the central caudal rays. The body is silvery on the lower sides, but the upper sides and back are brownish. The outer tips of the anal-fin rays are black. The inside of the operculum as well as the peritoneum are blackish.

Distribution and Natural History

Range. It is probably present throughout the Andes in the Orinoco Basin in Venezuela and Colombia.

Apure distribution. Map: fig. 81. To date it has been taken only in the western portion of the Apure drainage, in piedmont and montane streams and rivers.

Habitat. Fast-flowing montane streams with clear water and rocky substrates are the principal habitat of this species.

Abundance. UNCOMMON.

Number of specimens examined. 105 from 10 collections.

Food. OMNIVORE. This species undoubtedly feeds in a similar manner to *A. metae* and *A. integer*, taking seeds, fruits, insects, and other items that are washed down with the current.

Reproduction. Strategy probably r2. Spawning is probably annual and synchronized with the onset of the rainy season.

Brycon bicolor Pellegrin 1909

Palambra, Bocón - Brycon, South American Trout

Figs. 41c & 82. Map: fig. 83. Couplet 47b.

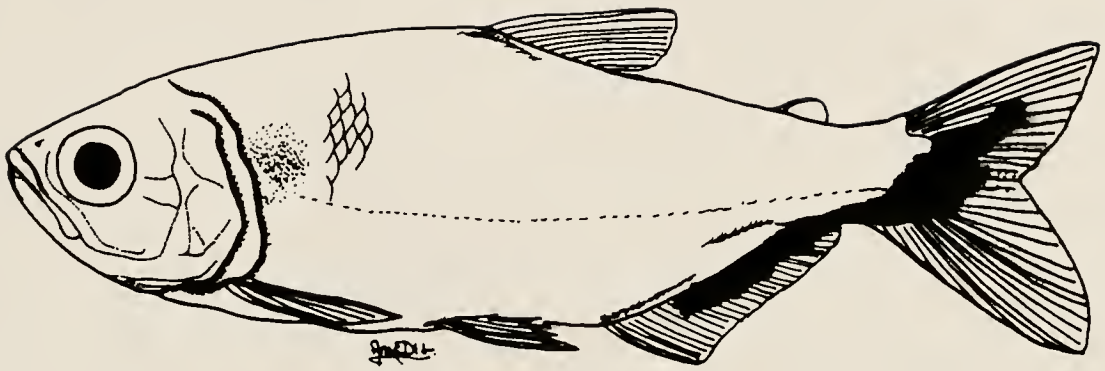


Figure 82. Brycon bicolor.

Generic synonymy

Brycon Müller & Troschel 1844:90 (type species: Brycon falcatus Müller & Troschel 1844:90, by original designation.)

Chalcinopsis Kner 1863:226 (type species: Brycon striatulus Kner & Steindachner in Kner 1863:226, by original designation.)

Megalobrycon Günther 1869:423 (type species: M. cephalus Günther 1869, by original designation).

Catabasis Eigenmann & Norris 1900:349 (type species: C. acuminatus Eigenmann & Norris 1900, by original designation).

Bryconodon Eigenmann 1903:33 (type species: Brycon orthotaenia Günther 1864, by original designation).

Othonophanes Eigenmann 1903:145 (type species: Brycon labiatus Steindachner 1879:75, by monotypy.

Triurobrycon Eigenmann 1909:33 (type species: Brycon lundii Reinhardt 1874, by monotypy).

Holobrycon Eigenmann 1909:33 (type species: Brycon pesu Müller & Troschel 1845:16,30, by original designation).

Specific synonymy

Brycon bicolor Pellegrin 1909:12 (type locality: Orinoco), not seen; Myers & Weitzman 1960:103; Mago L. 1970:69; Géry 1977:339 (key); Howes 1982:11 (review of genus, synonymy).

Brycon falcatus Román 1985:164 (Venez.).

Types. Paratypes MNHN 87-746-748 (111,114.5 and 118. 5 mm SL).

Comments. The identification of the Apure drainage specimens is still in doubt, though the form matches the description given by Howes (1982) fairly well, the color pattern seems to be variable, and quite similar for several species described from or reported from Venezuela.

Other possibilities could be Brycon longiceps Steindachner 1879, which was reported for Venezuela from Ciudad Bolivar by its describer as well as by Eigenmann and Eigenmann (1891), who probably were merely repeating the earlier citation. B. coquenani Steindachner 1915 was described from the Coquenan River in Venezuela.

Etymology. BRYCON = "gnasher of teeth" from the Greek, according to Howes (1982), but Eigenmann (1903) gave a different meaning, "to devour" and yet another ("greedy eater") in 1927; BICOLOR = of two colors, probably referring to the silver body with black markings.

Description

Illustrations. Figs. 41c & 82; Howes 1982:13 fig.8 (drawing of holotype). Román 1985:165, (photo misidentified as B. falcatus).

Diagnosis. The color pattern readily distinguishes this species from B. whitei (see figs. 41c and 82).

Size. This species grows to at least 250 mm SL.

Morphology. The premaxillary teeth are in three rows, as in all Brycon. The first row has 8-10 teeth, the second 8-9, and the third only two. The lateral line is complete. Howes (1982, Table 5) gave measurements of the three paratypes.

Counts. DR 11; AR 26-28; PR i13; VR i7; LLS 55-62; TS 15 above, 9 below LL; maxillary teeth 23-27; inner dentary teeth 18-22; GR 14-16.

Pigmentation. A dark band extends obliquely from the base of the caudal peduncle to across the upper lobe of the caudal fin (much as in Astyanax metae). The pigment on the anal fin begins at about the base of the ninth ray and widens to cover the remainder of the fin posteriorly. Howes (1982) considered this color pattern fins to be diagnostic for this species, however, the black pigment is quickly lost in preservative.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 83. This species is known only from the eastern portion of the drainage, in Guárico state, from the sandy soils and black waters of the Aguaro River system.

Habitat. It frequents clearwater rivers with sandy or rocky substrates, as well as blackwater streams and large rivers, and morichales that drain the sandy-soiled savannas of the easternmost portion of the Apure drainage.

Abundance. RARE.

Number of specimens examined. 3 from 3 collections.

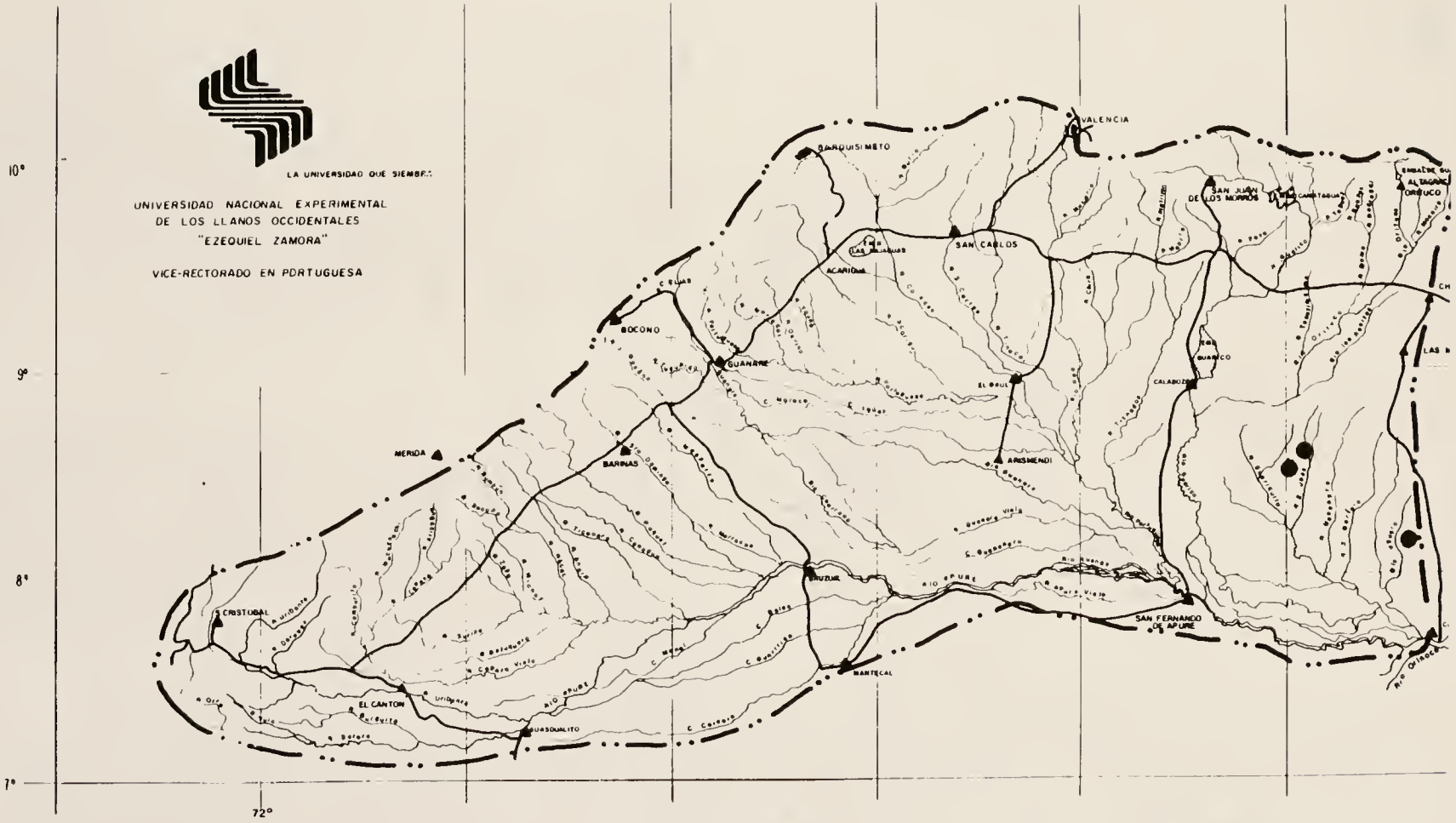
Food. OMNIVORE. B. bicolor probably feeds on all sorts of small animals, fishes, fruits and seeds, as do most members of the genus. I have observed this species while diving. The fishes stayed in an ill-defined school, roving from one end of the pool to the other.

Reproduction. Strategy: r2. Spawning is probably annual and synchronized with the onset of the seasonal rains.

Migrations. Though this species is not definitely known to do so, it probably migrates in conjunction with the wet-dry season changeovers, as do many similar species of Brycon present in Brazil and Argentina.

Importance. This species is a food fish of native peoples, and an increasingly popular sport fish with spear fishermen and hook and line anglers. It is seldom seen in the commercial catch because they are not easily obtained in large numbers.

Figure 83. Apure drainage distribution of *Brycon bicolor*.



CUENCA DEL RIO APURE

Brycon whitei Myers & Weitzman 1960

Palambra - South American Trout

Fig. 41b & 84. Map: fig. 85. Couplet 47a.

Specific synonymy

Brycon whitei Myers & Weitzman 1960:99, fig. 1 (type locality: vicinity of Los Micos, north end of the Cordillera Macarena, ~3° 20' N 73° 56' W, headwaters of the Río Guaviare (just south of Villavicencio, Colombia), seen; Mago L. 1970:69; Cala 1977:1; Géry 1977: 335,339; Howes 1982:46; Lilyestrom & Taphorn 1983:53 (biology).

Types. Holotype: CAS-SU 48818; Paratypes: CAS-SU 44817.

Etymology. WHITEI = after General Thomas D. White who collected the type specimens.

Description

Illustrations. Figs. 41b & 84; Myers & Weitzman 1960:100. Géry 1977:325, (as unidentified Brycon from Río Aguaro, Venezuela); Román 1985:165; Lilyestrom & Taphorn 1983:55, 57.

Diagnosis. The presence of a continuous black lateral stripe from the opercle to the tips of the central caudal-fin rays readily distinguishes this species from B. bicolor.

Size. Specimens of at least 450 mm SL were once fairly common, but these days usually younger, smaller specimens are seen (about 250 mm SL). Pollution and deforestation have taken a heavy toll.

Morphology. See Myers and Weitzman (1960) for a complete description. The upper jaw teeth are arranged in three or four rows, (depending on how you define the rows). This species is slender when young, but as it matures individuals become increasingly heavier and deeper bodied.

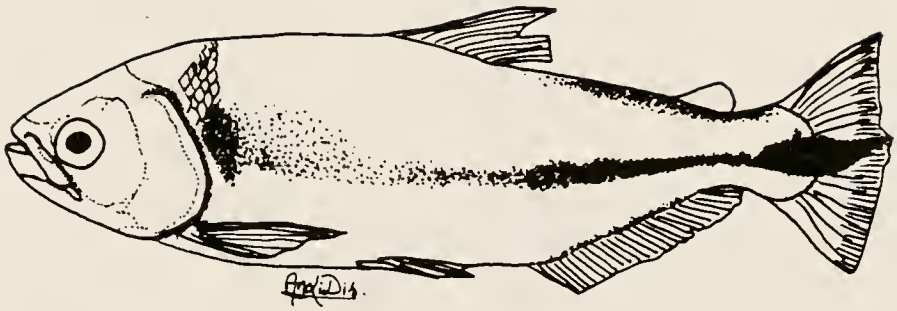


Figure 84. Brycon whitei.

Counts. DR 11; AR iii21-iii22; LLS 66-70 (given as 66 + 4 or 5 in description).

Measurements. GBD 3.1-3.2 in SL; HL 4.0-4.2. The length - weight curve for this species is log P = -1.73 + 3.049 Log L (n = 68, r = 0.933) P is the weight in grams and L is the standard length in cm.

Pigmentation. The body is silvery to golden, darkest dorsally, and lighter on the sides with the belly whitish. The wide, black lateral stripe is prominent, and continues out onto the central caudal rays. A faint humeral spot is located just above the origin of the lateral stripe. The pectoral and adipose fins are gray in preservative, but in life these fins (especially the caudal) have yellow to red tints.

Distribution and Natural History

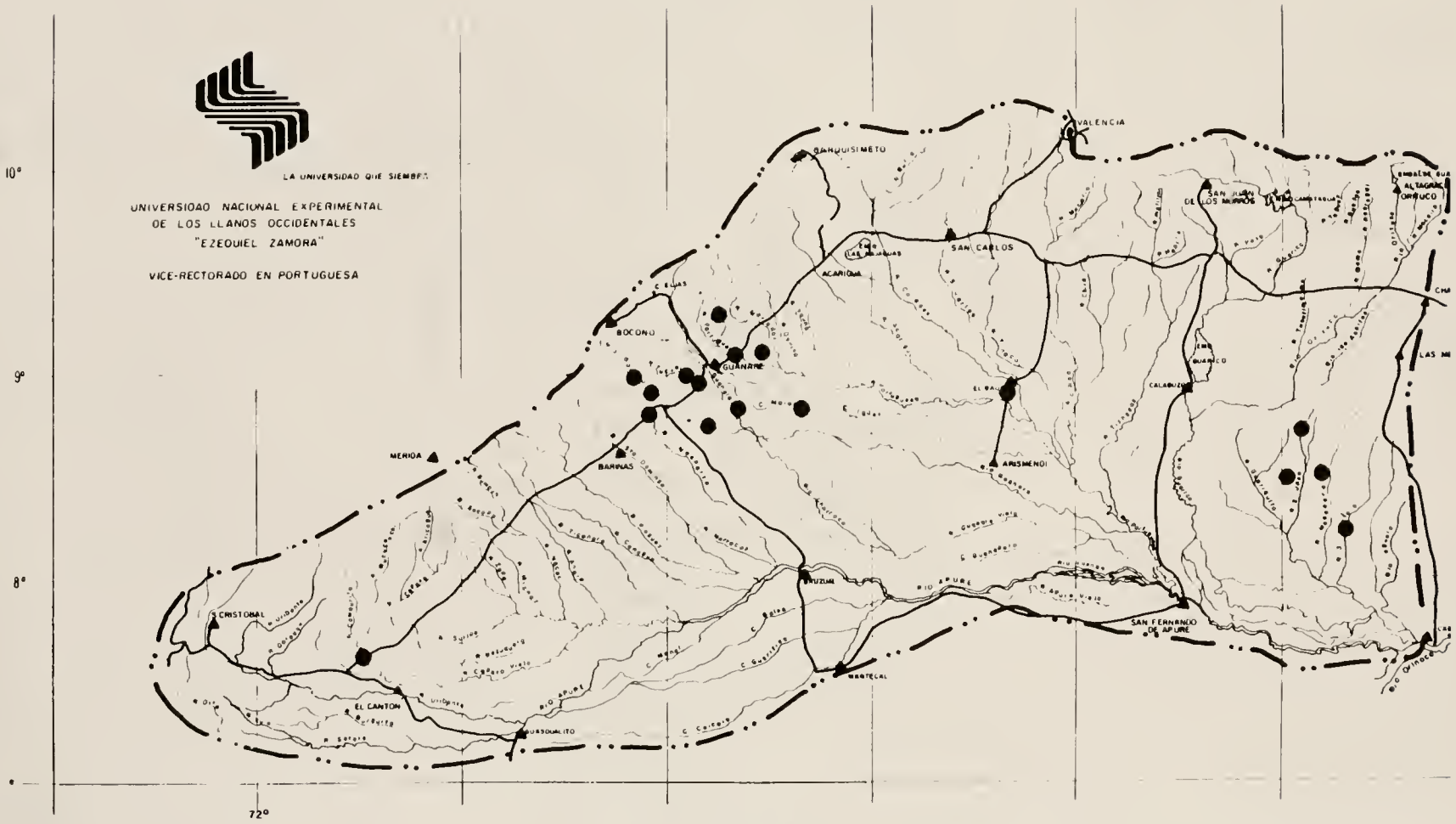
Range. Orinoco Basin in Colombia and Venezuela.

Apure distribution. Map: fig. 85. The palambra is found in montane, piedmont and upper llanos streams in the Andes, and in the upper reaches of the Aguaro River system.

Habitat. This species inhabits mountain, piedmont and high llaneran streams and rivers. It prefers clear waters, with little or no sediments, strong currents, and high levels of dissolved oxygen. The water temperature is usually between 24 and 28° C, with the pH nearly neutral. It is seen in both pools and rapids, but is more common where the gallery forest that provides most of the species' diet is intact. The substrate is sand, gravel or rock in their favored haunts. It is usually seen in groups, rarely alone.

Abundance. UNCOMMON. Since this species easily avoids nets, its true abundance may be greater than indicated by our collections. It is still fairly common in Andean streams not yet affected by deforestation

Figure 85. Apure drainage distribution of *Brycon whitei*.



CUENCA DEL RIO APURE

or pollution. In the upper Río Caparo in 1980, this species was still quite abundant; however, that river has since been dammed.

Number of specimens examined. 42 from 24 collections.

Food. OMNIVORE. Seeds and terrestrial insects comprised the diet of specimens examined by K. Winemiller (pers. com.). It readily accepts *Astyanax integer* used as bait, indicating that small fishes are also taken. Lilyestrom & Taphorn (1983) found 82% of 68 specimens dissected to contain vegetable material (flowers, leaves and seeds from trees), with only 11.3% containing animal remains, including caterpillars, grasshoppers, fish and a lizard.

Reproduction. Strategy: r2. Generation time: 24 months. fecundity: over 170,000 eggs/female; egg diameter 1.5 mm. Spawning is annual, and occurs during the first month of the wet season (Winemiller & Taphorn 1989). Lilyestrom & Taphorn (1983) found specimens in February (middle dry season) with gonads just beginning to mature.

Migrations. It is known to migrate extensively up (at the beginning of the dry season, Oct.-Dec.) and downstream (with the onset of the rains in May to June).

Importance. An excellent and highly sought sport fish, also important in subsistence fishing, this species is currently in danger of local extinction. It has already been eliminated from large areas due to habitat loss, alteration and pollution.

Bryconamericus sp.

Sardinita - Tetra

Figs. 58 & 86. Map: fig. 87. Couplets 79b & 92b.

Generic synonymy

Bryconamericus Eigenmann *in* Eigenmann, MacAtee & Ward 1907:139 (type species: *B. exodon* Eigenmann 1907, by monotypy).

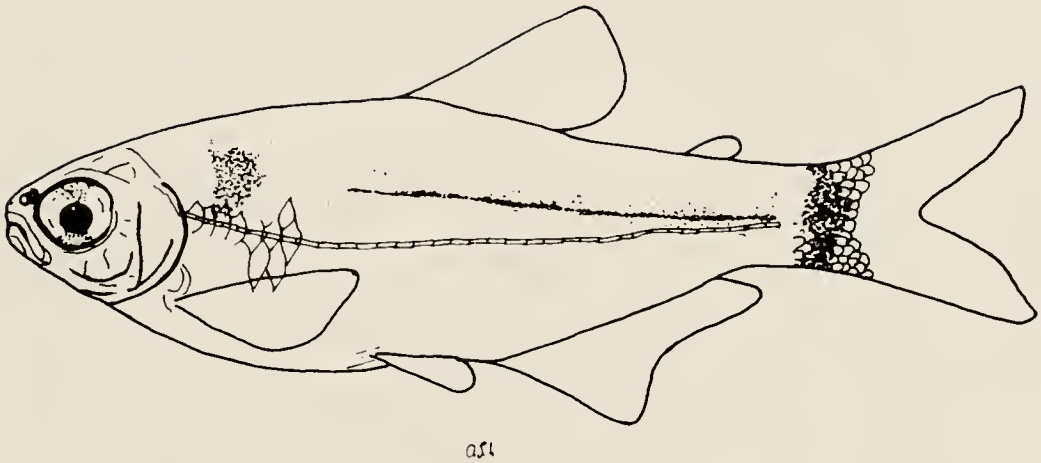


Figure 86. Bryconamericus sp.

Knodus Eigenmann 1910:216 (type species: Knodus meridae Eigenmann 1911, by monotypy).

Comments. The pigmentation pattern of this species doesn't agree well with that of any described Bryconamericus. It probably represents a new species.

Etymology. BRYCON = is from the Greek for "gnasher of teeth" according to Howes (1982), but Eigenmann (1903) gives a different meaning, "to devour" and yet another "greedy eater" in 1927; AMERICUS = from the Americas, South America in this case.

Description

Illustrations. Figs. 58 (caudal pigmentation) & 86.

Diagnosis. This species is distinguished by its low number of anal-fin rays (usually 24-25, but up to 27). B. beta usually has 27-30 rays, rarely 26 or 31, and B. deuterodonoides has a maximum of 18. It is further distinguished from B. beta by not having the lateral stripe continued through the central caudal-fin rays, as is characteristic of that species.

Size. This fish seldom exceeds 50 mm SL, and most individuals are usually between 30-40 mm.

Counts. DR 10; AR 24 (18), 25 (22), 26 (8), 27 (2).

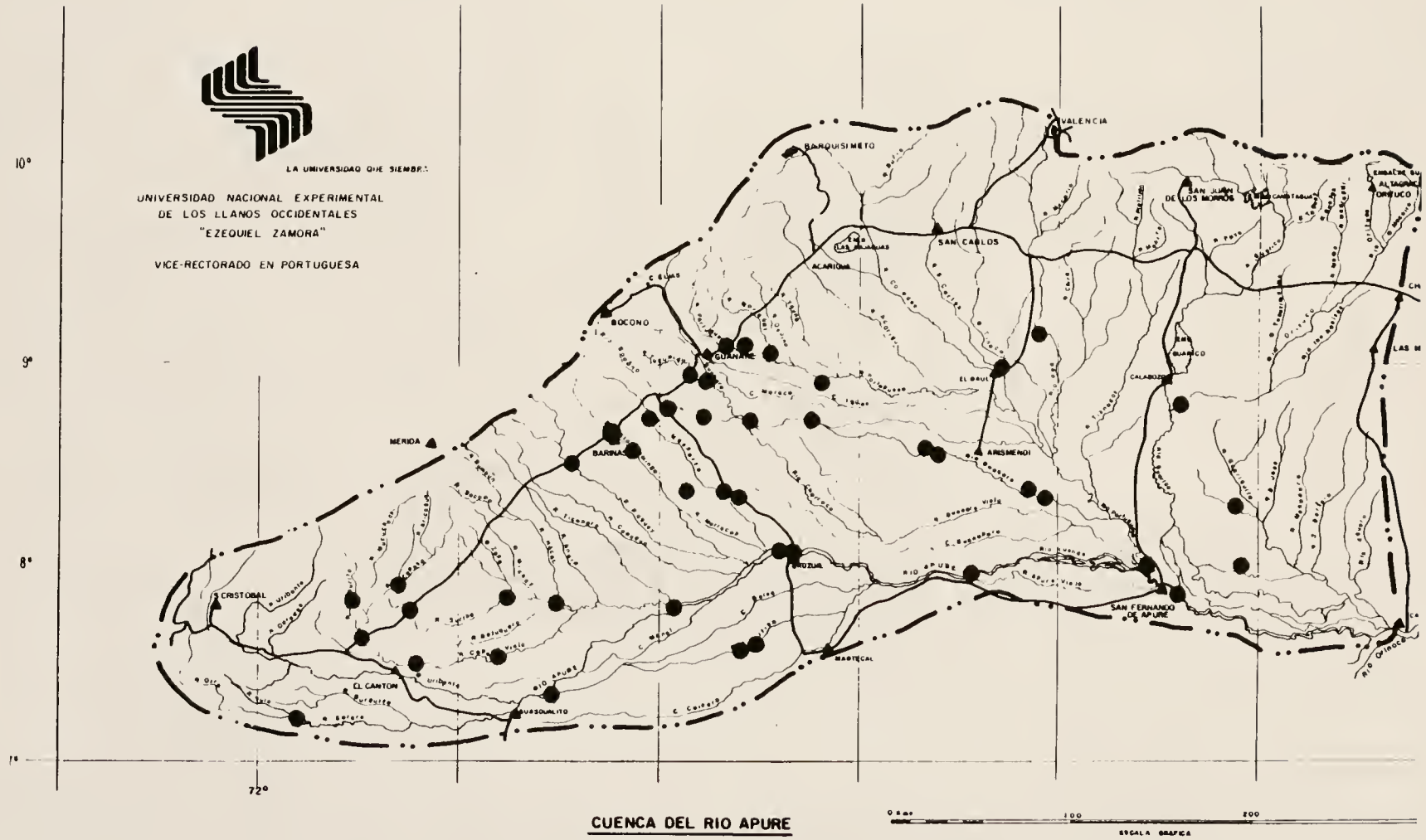
Pigmentation. The body is plain silvery in life, sometimes with a faint lateral stripe. The fins are colorless. Pigment at the base of the caudal fin forms a faint vertical crescent.

Distribution and Natural History

Range. Orinoco Basin.

Apure distribution. Map: fig. 87. This species is most common in the low llanos, but also ranges into the mountains.

Figure 87. Apure drainage distribution of Bryconamericus sp.



CUENCA DEL RIO APURE

Habitat. It inhabits whitewater rivers, and is more common in the main river channels than the other two species.

Abundance. COMMON.

Number of specimens examined. 3,096 from 77 collections.

Food. OMNIVORE. This species diet consists of seeds, insects, and microcrustaceans.

Reproduction. Strategy: probably r1. It probably spawns in the shallows of the rivers and the flooded plains during the annual floods.

Bryconamericus beta Eigenmann 1914

Sardinita - Tetra

Fig. 57 & 88. Map: fig. 89. Couplet 92a.

Specific synonymy

Bryconamericus beta Eigenmann in Eigenmann, Henn & Wilson 1914:7 (type locality: Villavicencio, Colombia), seen; Eigenmann 1920:11 (Concejo, Río Tiquirito, Venez.); 1922:236 (northern Venezuela); 1927:389, pl. 91, fig.2 (key, redescription); Schultz 1944b:340; Mago L. 1970:69.

?Bryconamericus sp. Eigenmann 1920:11 (Lake Valencia, Venez.).

Knodus beta Géry 1977:395.

Types. Holotype: FMNH 56648 (formerly CM 5465a), examined. Paratypes: FMNH 56649 (formerly CM 5466a-d), CAS 39492(4) (formerly IU 13158) all examined.

Comments. The form present in the Apure drainage is nothing like the types of B. beta, but traditionally has been identified as such. It has several more lateral-line scales than the types of B. beta and is similar to B. caucanus (in Géry [1977] it will key out to that species), but the latter is deeper bodied and supposedly limited to the

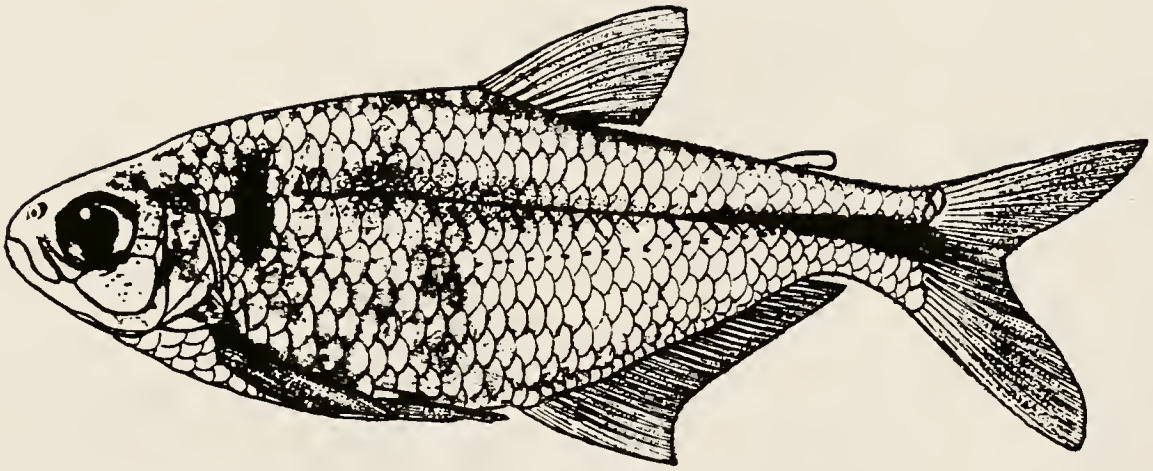


Figure 88. Bryconamericus beta.

Cauca drainage in Colombia. It is also similar to B. osgoodi from the upper Amazon drainages of Peru, but that species is known only from the type. There seems to be little to differentiate B. beta and B. alpha, both described by Eigenmann from Villavicencio, Colombia. A careful revision of material from all of the Andean headwaters of the Orinoco will be necessary to unravel this problem.

Etymology. BETA = second.

Description

Illustrations. Figs. 57 (caudal stripe) & 88; Eigenmann 1927:389, pl. 91, fig. 2.

Diagnosis. The lateral stripe continues onto the central caudal rays in this species, as opposed to the situation in Bryconamericus sp. Though there is some overlap, B. beta beta usually has 27-31 anal rays, vs 24-26 in B. sp. B. deuterodonoides has only 17-18 anal-fin rays.

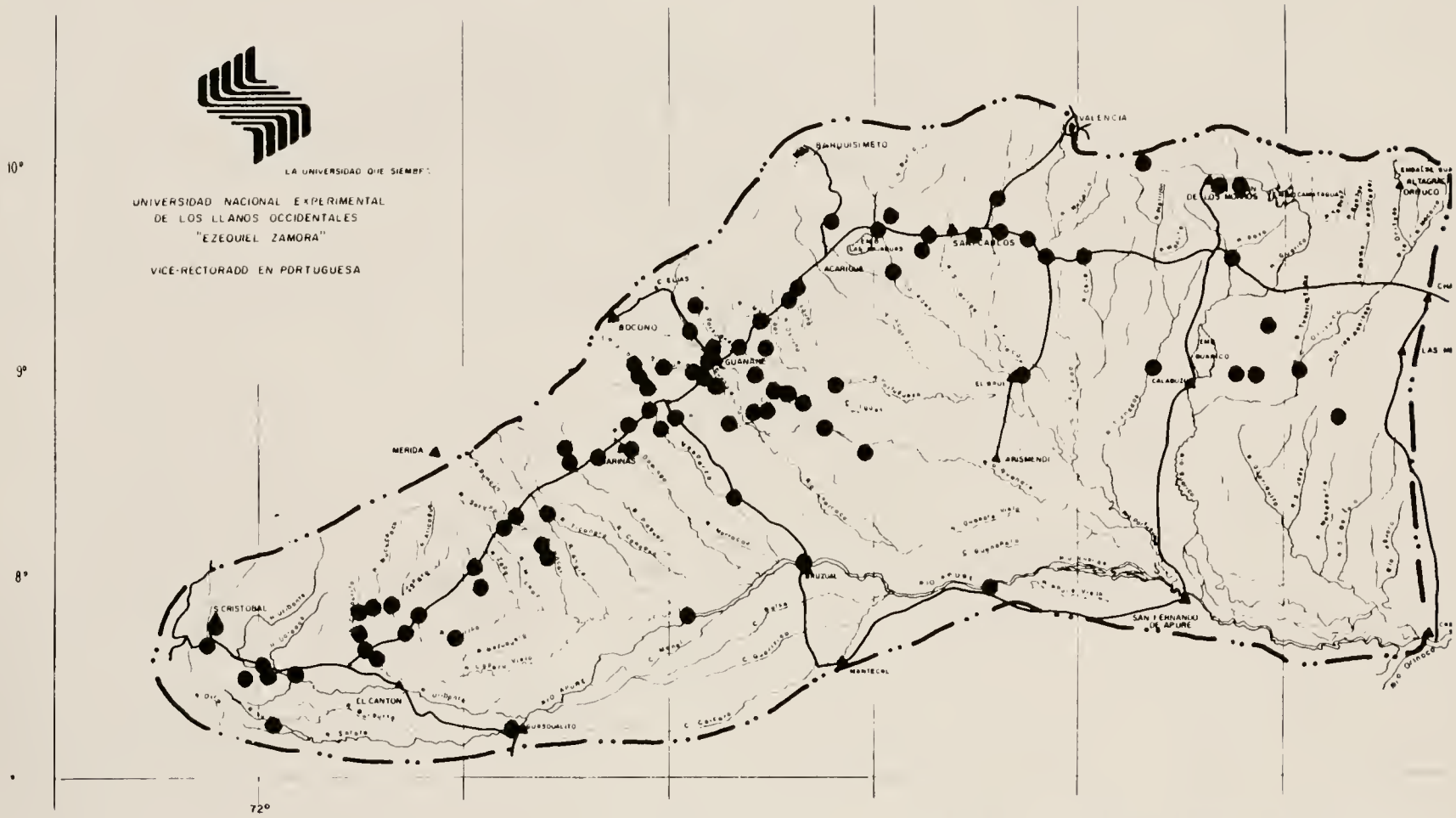
Size. This species reaches about 50 mm SL, but most individuals are between 30-40 mm.

Morphology. The anal fin has a sheath of scales anteriorly and the caudal fin is scaled on only about 1/4 of the lower lobe. The lateral line is complete. The branched rays of the pelvic fins in males have hooks.

Counts. DR ii8; AR 26(2), 27(9), 28(14) 29(13) 30(10) 31(4); PR 12; VR i7; LLS 34-38, TS 12; premaxilla with 4-4 teeth, maxilla with two.

Pigmentation. The humeral spot is vertically elongate but vague in many specimens. The lateral stripe is continuous with the humeral spot, but faint anteriorly. It widens on the caudal peduncle and extends out onto the central caudal rays, but not usually to their tips. All fins

Figure 89. Apure drainage distribution of Bryconamericus beta.



CUENCA DEL RIO APURE

have some peppering of pigment. The dorsal scales are outlined with pigment and there is a concentration of pigment between the pelvic fins.

Distribution and Natural History

Range. Orinoco Basin.

Apure distribution. Map: fig. 89. This species is most common in the upper part of the Apure drainage, though scattered lowland localities have been found.

Habitat. This species occurs in upland rivers with moderate to fast currents and rocky substrates, as well as in smaller shaded streams in the mountains.

Abundance. COMMON.

Number of specimens examined. 2,838 from 140 collections.

Food. OMNIVORE. Their diet includes terrestrial insects, small seeds, and aquatic insects (K. Winemiller, pers. com.)

Reproduction. Strategy: r1; fecundity: 796 eggs/female; egg diameter: 0.95 mm; generation time: 4 months. This species probably spawns throughout the year. Individuals may reproduce more than once a year (Winemiller & Taphorn 1989).

Bryconamericus deuterodonoides Eigenmann 1914

Sardinita - Tetra

Fig. 90. Map: fig. 91. Couplet 81b.

Specific synonymy

Bryconamericus deuterodonoides Eigenmann in Eigenmann, Wilson & Henn 1914:7 (type locality: Villavicencio, Colombia, Río Negro [quebrada]), seen; 1927:389 pl.91 fig.2; Fowler 1943:240; Géry 1977:387 (key).

Bryconamericus deuterodonoides deuterodonoides Schultz 1944b:340 (key); Inger 1956:435 (key).

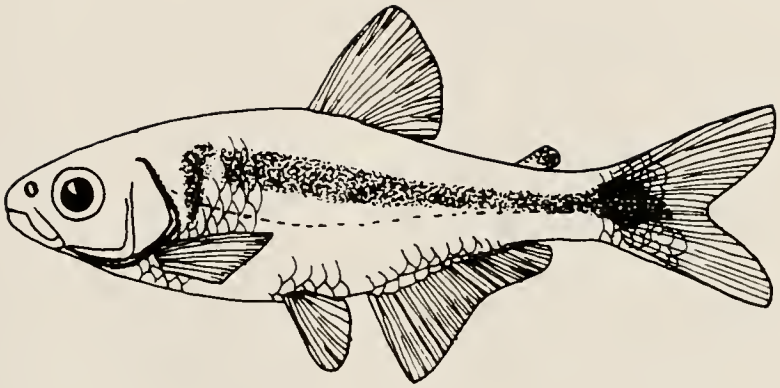


Figure 90. Bryconamericus deuterodonoides

Types. Holotype: B. deuterodonoides FMNH 56644 (formerly CM 5461), examined. Paratypes CAS 61221(6) (formerly IU 13156), examined.

Comments. Schultz (1944b) described B. d. euryodous from the Río Guárico and tributaries between San Sebastián and San Casimiro, and from Caripito, Venezuela (types USNM 121468).

The holotype of B. d. caudovittatus Inger (FMNH 45706) has a black streak through central caudal rays, four teeth in inner premaxillary row, 2-3 in outer, and two very wide maxillary teeth.

The holotype of B. d. deuterodonoides (FMNH 56644), from Villavicencio, Colombia in the Meta river drainage has three large, wide teeth on the maxilla, with four teeth in the inner and 2-3 in the outer premaxillary row. It has the base of the tail scaled. It has neither a lateral stripe, nor any other pigment remaining. It is very similar to Venezuelan specimens, but has a differently shaped head.

The subspecies described by Schultz (1944b) and Inger (1956) hardly seem justified unless further distinctions can be demonstrated.

Schultz (1944b) himself questioned the difference between B. cismontanus Eigenmann 1914 and B. deuterodonoides, both described in the same paper along with B. alpha and B. beta, all four from the same locality at Villavicencio, Colombia. Thus, four sympatric species of Bryconamericus are described from the Andean piedmont of the Meta drainage. Since I have found three species in the Apure drainage, this is perhaps possible, but it will take comparison of fresh collections from Villavicencio with the Apure material to make final determinations.

Etymology. DEUTERODON = Deuterodon is a genus of characid, OIDES = like; referring in this case to the similar teeth.

Description

Illustrations. Fig. 90; Eigenmann 1927: 389 pl. 91 fig. 3 (photo of types).

Diagnosis. B. deuterodonoides has only 17-18 anal-fin rays. This immediately distinguishes it from other Bryconamericus in the Apure drainage, since those species have 24 or more. The subspecies B. d. euryodous Schultz 1944b, and B. d. caudovittatus Inger 1956 are reported to have four teeth in the outer row of the premaxilla, versus only two in B. d. deuterodonoides, and they allegedly differ in branched anal-fin ray counts and gill-raker number (Inger 1956).

Size. It grows to about 50 mm SL, but most individuals are smaller, 30-40 mm.

Morphology. This species is more oval in cross section, and not as compressed as B. beta. It has a modified, elongate axillary scale, and a complete lateral line.

Counts. DR ii8; AR ii15-16; PR 12; VR i7; LLS 34-35; TS 10; premaxillary teeth 4-4, maxilla with three, dentary with nine. Inger (1956) reported six upper and 9-10 lower gill-rakers on the outer arch in the holotype and paratypes of B. d. deuterodonoides.

Pigmentation. The humeral spot is dark, with a pale area in front and behind it. There is no caudal spot. The lateral stripe begins just behind the humeral spot (which it does not touch) and continues onto the tail, but fades before reaching the tips of the central caudal rays. Flecks of black pigment in the dorsal, adipose and anal fins are concentrated distally. The dorsum has numerous black specks, but the dorsal midline is darkest. The nose, lips and chin are flecked with melanophores, and the cheeks are white with red dorsally.

The eye is black below the pupil. The upper base of the caudal fin has a characteristic red to yellow dot in life.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 91. It is mostly limited to Andean piedmont and montane streams.

Habitat. This species is found in upland, white and clearwater streams and rivers, usually over rocky substrates.

Abundance. COMMON.

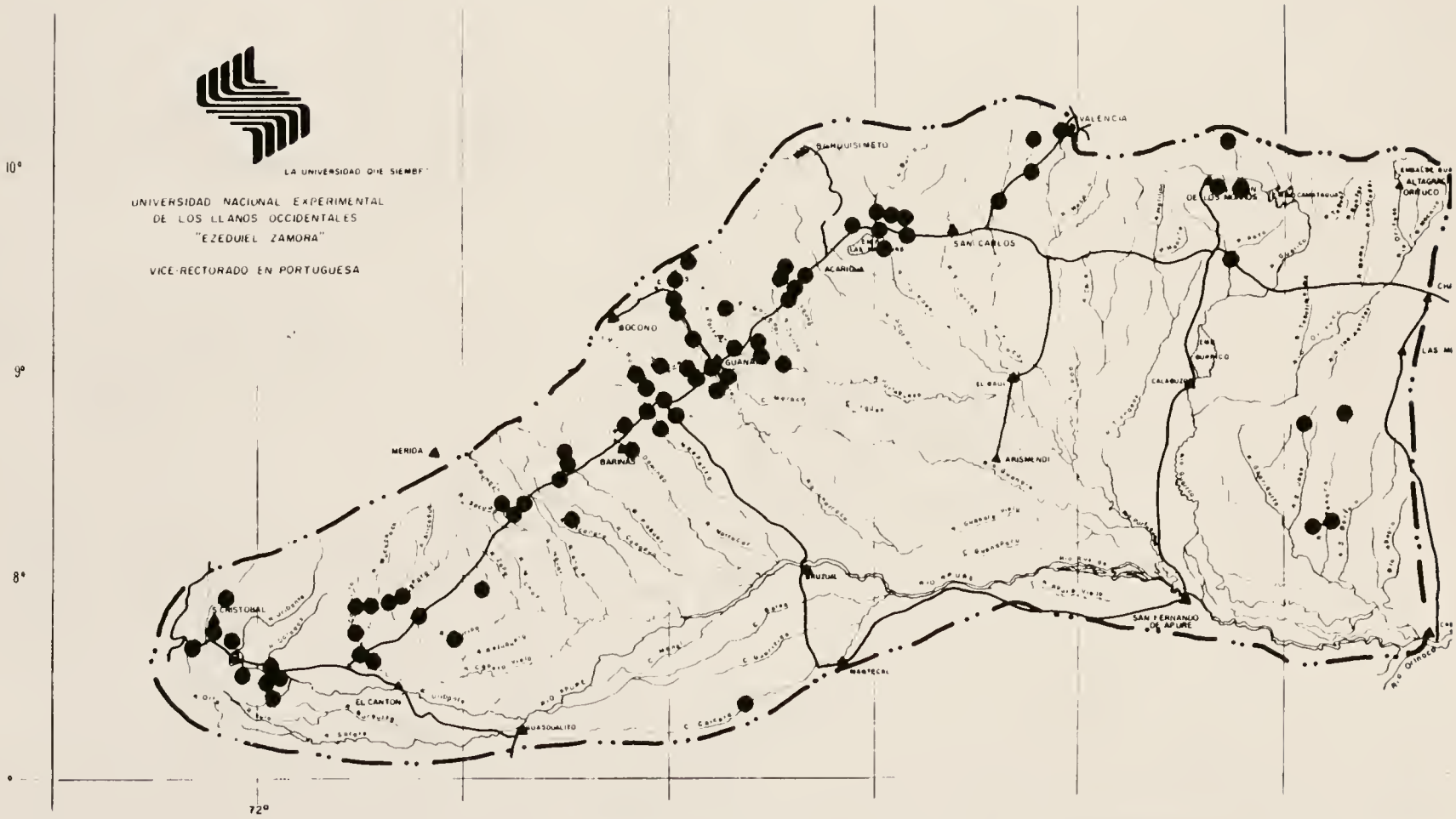
Number of specimens examined. 5,187 from 117 collections.

Food. OMNIVORE. Its diet includes aquatic insects, small seeds, and terrestrial insects.

Reproduction. Strategy: r1; fecundity: 243 eggs/female; egg diameter: 0.85 mm; generation time: about 6 months. Individuals probably spawn more than once a year (Winemiller & Taphorn 1989).

An extremely unusual reproductive strategy is employed by this species. It spawns in the piedmont of the Andes, during the low water period of the dry season. Millions of tiny (2-8 mm), recently-hatched larvae were collected by Alex Flecker and collaborators while sampling aquatic insect drift at night, in the Las Marias and Masparro rivers near Guanare during the peak of the dry season in January and February. This phenomenon has been repeated now two years in row, and thus seems to be a regular occurrence. This extremely unusual mode of breeding has yet to be explained. The larvae are present at low water, when predators would seem to be concentrated in the little remaining water flow. I was able to rear a few larvae to a large enough size to permit identification. To my knowledge, this is the only characiform fish reported to have this mode of reproduction.

Figure 91. Apure drainage distribution of Bryconamericus deuterodonoides.



CUENCA DEL RIO APURE

Importance. It has minor potential as an ornamental.

Bryconops (Creatochanes) affinis (Günther) 1864

Sardinita - Tetra

Figs. 42b & 92. Map: fig. 93. Couplet 48b.

Generic synonymy

Bryconops Kner 1859:43 (type species: Bryconops alburnoides Kner 1859), by original designation.

Creatochanes Günther 1864:329 (type species: Salmo melanurus (Bloch) 1794, by subsequent designation of Eigenmann 1910:435.

Specific synonymy

Tetragonopterus affinis Günther 1864:327 (type locality: British Guiana), seen.

Tetragonopterus rutilus (not of Jenyns) (part), Boulenger 1900:2.

Creatochanes affinis Eigenmann 1891:56; 1910:435; 1912:345; 1918:pl. 2, fig. 5; 1921: pl. 23, fig. 3; 1922:237; Eigenmann & Myers 1929:436; Norman 1926:92 (key); Tortonese 1941-42:117.

Bryconops (Creatochanes) melanurus Müller & Troschel (not of Bloch) 1848:635.

Creatochanes melanurus Eigenmann & Eigenmann 1891:56; Eigenmann 1910:435; Steindachner (part) 1915:35.

Bryconops melanurus Bertoni 1939:55 (Paraguay).

Bryconops (Creatochanes) affinis Knöppel, Junk & Géry 1968:245 (key); Géry 1977:435 (key).

Comments. The identification of this species is tentative. It keys to B. affinis in Géry (1977), but doesn't agree very well with the original description, especially in relation to the lateral-line scale count. It is probably a new species.

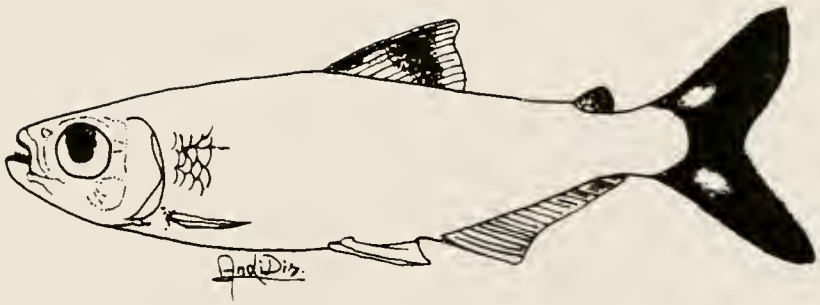


Figure 92. Bryconops (Creatochanes) affinis.

Etymology. BRYCON = is from Brycon a characid genus, OPS = like; AFFINIS = similar to.

Description

Illustrations. Figs. 42b (maxilla length) & 92; Knöppel et al. 1968:233 (photo), 242 (caudal pattern); Géry 1977:435 (head).

Diagnosis. The species of Bryconops are long, spindle-shaped tetras, with a long maxilla that extends well behind the anterior edge of the orbit and well below the ventral edge of the orbit. B. affinis has more lateral-line scales (54-60) than B. melanurus (43-45), the only other species found so far in the Apure drainage. The pigment in the caudal fin is more symmetrical than in B. melanurus, with both lobes being darkest along their outer edges, with diffuse lighter yellow or orange near each lobes' base.

This species might be confused with Iguanodectes spilurus, but lacks the characteristically shaped, multicuspid teeth of that species.

Size. This fish is usually taken at about 60 mm SL, but grows to almost 90 mm.

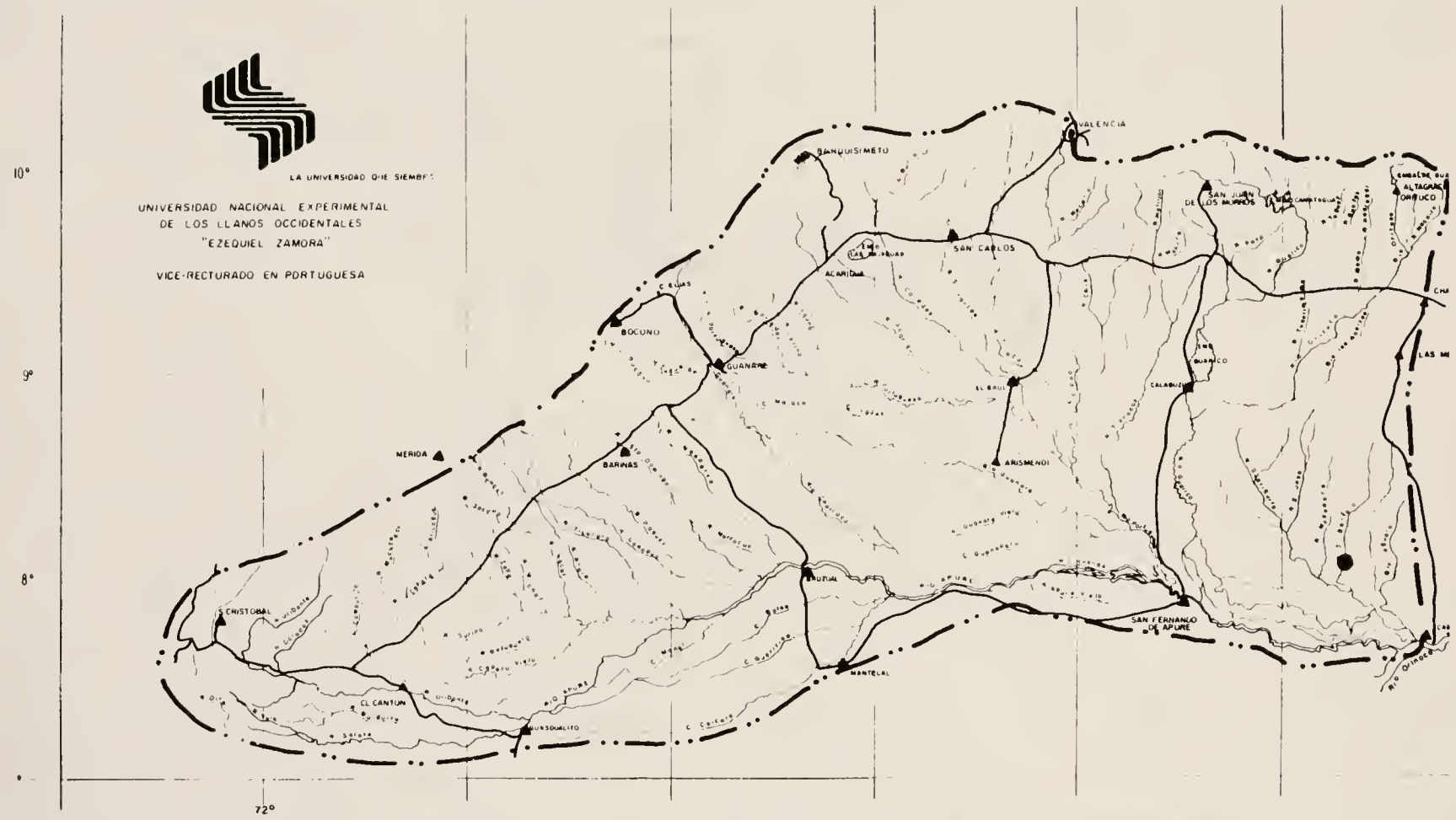
Morphology. The dorsal-fin origin is behind the pelvic-fin insertions. The lower caudal lobe is slightly longer than the upper.

Counts. DR ii9; AR iii31-iii33, (but given as 27 for type); LLS 54-60 (but given as 43 for type); PR i11-i12; VR i8; TS 8-9 above, 4-4 1/2 below LL.

Measurements. HL 23-25% SL; GBD 23-25% SL.

Pigmentation. The body is yellowish in preservative with a wide silvery lateral band from the opercle to the tail. The dorsal midline is marked with a black line. The dorsal, anal, pectoral and pelvic fins are clear, and often contain a few scattered melanophores along the rays.

Figure 93. Apure drainage distribution of *Bryconops affinis*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It is reported from the Amazon, Orinoco, and coastal drainages of Brazil, Venezuela, Guyana, French Guiana and Surinam.

Apure distribution. Map: fig. 93. It is known from only one site in the Aguaro River system.

Habitat. This fish inhabits blackwater streams and morichales of sandy savannas.

Abundance. RARE.

Number of specimens examined. 11 from 1 collection.

Food. OMNIVORE. It probably feeds on aquatic and terrestrial insects that fall to the water's surface or drift down with the current. It is usually observed actively swimming about in large schools.

Reproduction. Strategy: probably r1. It probably spawns repeatedly during the wet season.

Importance. Potentially valuable as an ornamental.

Bryconops (Creatochanes) melanurus (Bloch) 1794

Sardinita - Tetra

Fig. 94. Map: fig. 95. Couplet 88b.

Specific synonymy

Salmo melanurus Bloch 1794: tab. 381 fig. 2 (type locality: Surinam), seen.

Tetragonopterus melanurus Müller & Troschel 1845:14; Cuvier & Valenciennes 1848:155.

Creatochanes melanurus Eigenmann 1910:435; 1912:346; Norman 1926:92 (key); Eigenmann & Myers 1929:438 (description).

Bryconops (Creatochanes) melanurus Knöppel, Junk & Géry 1968:245 (key); Géry 1977:435 (range, key, description).

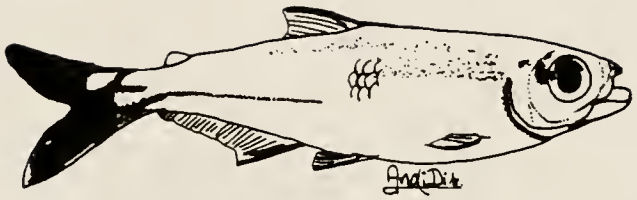


Figure 94. Bryconops (Creatochanes) melanurus.

Etymology. MELAN = black; URUS = tail.

Description

Illustrations. Fig. 94; Eigenmann 1912:pl. 50; Knöppel et al. 1968:232 (photo), 242 (caudal pattern); Géry 1977:420, 435 (head).

Diagnosis. The species of Bryconops are all long, spindle-shaped tetras, with a long maxilla that extends well behind the anterior edge of the orbit of the eye, and well below the ventral edge of the orbit. In addition, B. melanurus has about ten fewer lateral-line scales (43-45) than B. affinis (54-60), the only other species found so far in the Apure drainage. The pigment in the caudal fin is concentrated in the upper lobe.

This species might be confused with Iguanodectes spilurus but lacks the characteristically shaped, multicuspid teeth of that species and also has fewer lateral-line scales.

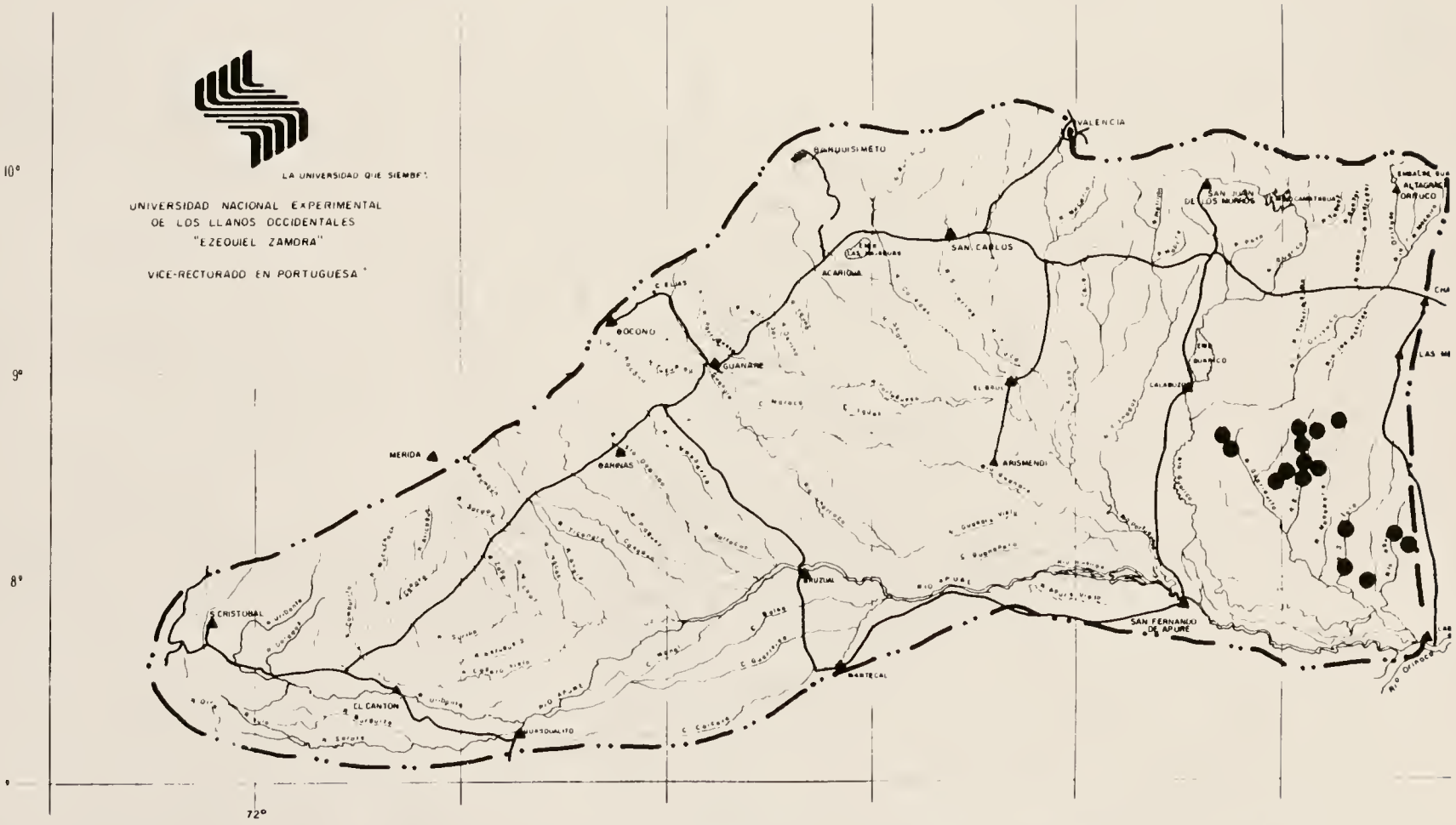
Size. It grows to about 60 mm SL.

Morphology. The greatest body depth measures 3 1/2 - 4 times in the standard length. The lateral line is complete and decurved in front. The origin of the dorsal fin is over the pelvic fin insertions.

Counts. DR ii9; AR iii24-iii26; PR i12-i13; VR i7; LLS 43-45; TS 7 above and 3 below LL.

Pigmentation. The body is yellowish in preservative, with a wide, silvery black lateral band from the opercle to the tail. The dorsal-midline is marked with a black line. The upper lobe of the caudal fin is edged in black and has a yellow to orange spot near its base. The lower caudal lobe is light colored, usually yellowish and the lateral stripe continues onto the central caudal-fin rays. The other fins are clear. The scales of the upper sides are outlined with gray.

Figure 95. Apure drainage distribution of *Bryconops melanurus*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in the Amazon, Orinoco and coastal drainages of Brazil, Venezuela, the Guianas and Surinam.

Apure distribution. Map: fig. 95. This fish is known only from the Aguaro River system, the easternmost in the Apure drainage.

Habitat. This species frequents the blackwater streams and morichales of the sandy savannas in the easternmost part of the Apure drainage.

Abundance. UNCOMMON. This species is abundant where found.

Number of specimens examined. 256 from 19 collections.

Food. OMNIVORE. This fish probably feeds on aquatic and terrestrial insects that fall to the water's surface or drift down with the current. It is usually observed actively swimming about in large schools.

Reproduction. Strategy: probably r1. It probably spawns repeatedly during the rainy season.

Importance. It is potentially valuable as an ornamental.

Catoprion mento (Cuvier) 1819

Caribe Jetudo - Wimple Piranha

Fig. 96. Map: fig. 97. Couplet 20b.

Generic synonymy

Catoprion Müller & Troschel 1844:96 (type species: Serrasalmus mento Cuvier 1819, by monotypy).

Specific synonymy

Serrasalmus mento Cuvier 1819:369 pl. 28 fig. 3 (type locality: Brazil?) (not seen).

Catoprion mento Müller & Troschel 1844:96 (British Guiana); 1845:22 pl.

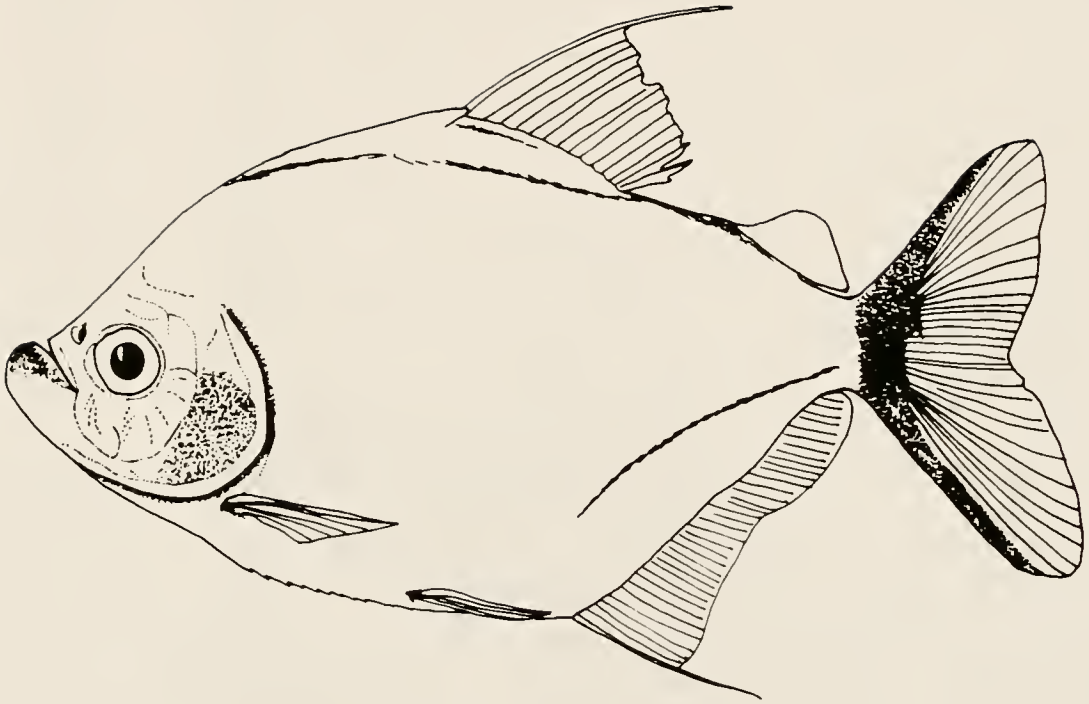


Figure 96. Catoprion mento.

2, figs 5, 5a; Eigenmann 1912:387, pl. 56, fig. 3 (key, description, Essequibo); Mago L. 1970:70; Géry 1972:207 (diagnosis); 1977:294 (key).

Comments. This genus is monotypic, but I suspect that closer examination of the different populations from the Amazon, Orinoco and Guyana will reveal at least subspecific differences. I have noticed considerable differences in lateral-line scale counts, number of serrae, and other meristic character between the Apure population and those reported from the Guianas (Géry 1972).

Etymology. CATO = probably from the Greek "kata" for lower, PRION = is from the Greek for saw, perhaps referring to the saw-toothed ventral keel in this species; MENTO = is from the Latin for chin, calling attention to the jutting lower jaw, or chin of this species.

Description

Illustrations. Fig. 52; Eigenmann 1912:pl. 56, fig. 3; Axelrod *et al*. 1971:F-164.00; Myers 1972:64, 85, 124; Géry 1977:293, 294; Blëher 1986:82, 84.

Diagnosis. *C. mento* is distinguished by a prominent, protuberant lower jaw and in having the first dorsal ray filamentous in larger, undamaged specimens. It is further characterized by its unusual tubercle-like teeth. The premaxilla has two large antrorse, conical teeth in the "outer" row, and three much smaller teeth in the "inner" row, which was called a "single irregular row" by Géry (1972). The mandible only has a single series of teeth.

Size. This fish grows to about 100 mm SL.

Morphology. The dorsal fin and anal fin are falcate, and in some aquarium specimens, a long filament forms on the dorsal fin. The body

is somewhat discoid and highly compressed. The belly is serrated as in most piranhas.

Counts. DR iiI4-16; AR 37-39; LLS 89-94; ventral serrae 32-34; GR 14.

Measurements. GBD 66% SL; Eye diameter about 2.7 in HL and equal to interorbital width, longer than snout.

Pigmentation. The body is silvery, with a faint humeral spot and a red spot on the opercle. The base of the caudal fin is black and the anal fin is reddish, with its first rays white and elongated.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins, from southern Brazil north to Venezuela, and in Guyana.

Apure distribution. Map: fig. 97. It is known only from northern Apure state and the Guariquito system in Guárico state.

Habitat. In the Apure drainage, *Catoprion mento* is restricted to blackwater streams with abundant aquatic vegetation. To be able to feed effectively, this species may need higher water clarity for enhanced visibility.

Abundance. UNCOMMON.

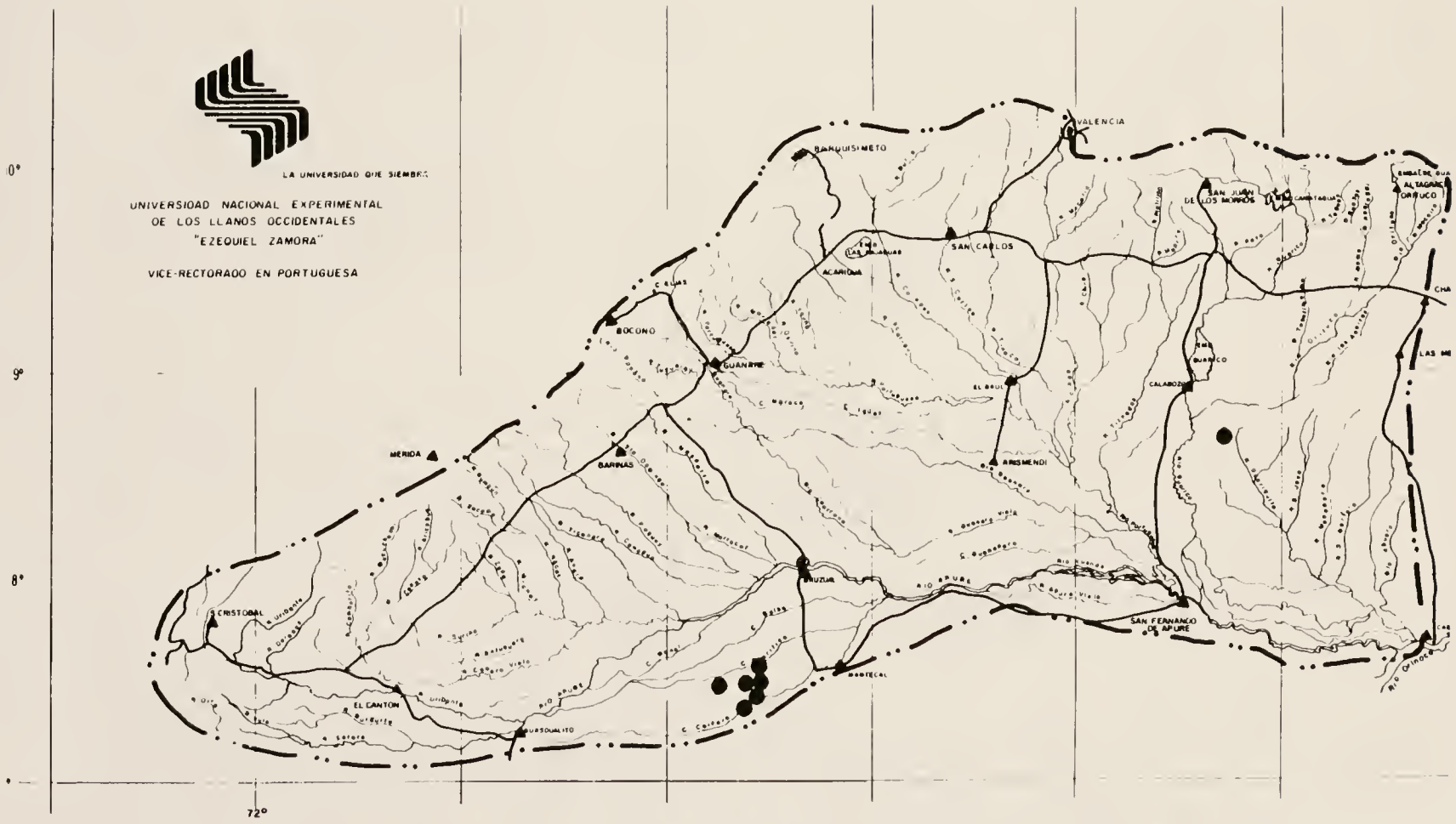
Number of specimens examined. 187 from 24 collections.

Food. CARNIVORE. Lepidophage. This species is known to feed almost exclusively on scales but it also may eat small fishes and insects (Nico & Taphorn 1986, 1988; Vieira & Géry 1979).

Reproduction. Strategy: probably r2. This species is probably an egg scatterer that spawns each year at the beginning of the rainy season.

Importance. Ornamental.

Figure 97. Apure drainage distribution of *Catoprion mento*.



CUENCA DEL RIO APURE

Charax gibbosus (Linnaeus) 1758

Dientón, Jibao - Glass Headstander

Figs. 30 (head) & 98. Map: fig. 99. Couplet 7b.

Generic synonymy

Charax Scopoli 1777:455 (type species: Salmo gibbosus Linnaeus 1758, by subsequent designation of Eigenmann 1910:444).

Characinus Lacepede 1803:269 (type species: Salmo gibbosus by subsequent designation of Jordan & Evermann 1917:66).

Epicyrtus Müller & Troschel 1844:92 (type species: Salmo gibbosus Linnaeus, by monotypy).

Anacyrtus Günther 1864:345 (type species: Salmo gibbosus Linnaeus, by subsequent designation of Jordan 1919:333).

Specific synonymy

Salmo gibbosus Linnaeus 1758:311 (type locality: Surinam), seen.

Epicyrtus gibbosus Müller & Troschel 1844:92 (type locality: South America).

Cynopotamus gibbosus Valenciennes, in Cuvier & Valenciennes 1849:(240) 321.

Anacyrtus gibbosus Eigenmann & Eigenmann 1891:56.

Characinus gibbosus Eigenmann & Kennedy 1903:525.

Charax gibbosus Eigenmann & Ogle 1907:32; Eigenmann 1912:400 (synonymy, key); Hensel 1962:127 (clarification of name); Géry 1977:301,307.

Roeboides microlepis Román 1985:161 (misidentified, Venez.).

Etymology. CHARAX = from the Greek for a palisade (Eigenmann 1927), in this case a palisade of teeth, but also given to mean a "gnasher of teeth" in Eigenmann's earlier works. Charax is a genus of characid frequently used in the formation of generic names; GIBBOSUS = refers to the hump-backed profile of the nape.

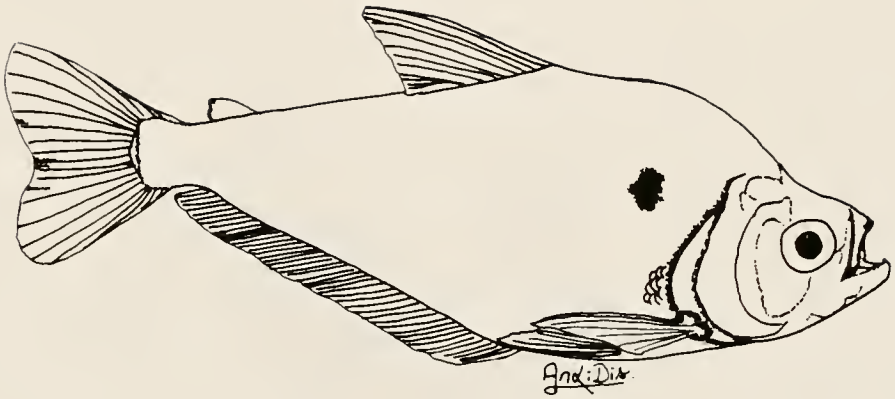


Figure 98. Charax gibbosus.

Description

Illustrations. Figs. 30 (head) & 98; Eigenmann 1912:pl. 60, fig. 3; Hensel 1962:128; Axelrod et al. 1971:F-171.00; Géry 1977:301. Román 1985:160, (misidentified as Roeboides microlepis, a species not known from Venezuela).

Diagnosis. The characteristic humped back is the first clue to the identity of this species. Small individuals of Roeboides, Cynopotamus and Charax can be very difficult to distinguish. This species is distinguished from Cynopotamus bipunctatus by possessing cycloid rather than ctenoid scales, and in having only 53-60 lateral-line scales versus over 100. It may be distinguished from Roeboides spp. by the lack of everted teeth or "tusks" on the upper jaw, and the presence of an elongated spiny projection of the cleithrum below the base of the pectoral fin (which is triangular or rounded in Roeboides spp).

Size. The glass headstander can grow to about 150 mm TL, but most individuals are between 60-100 mm.

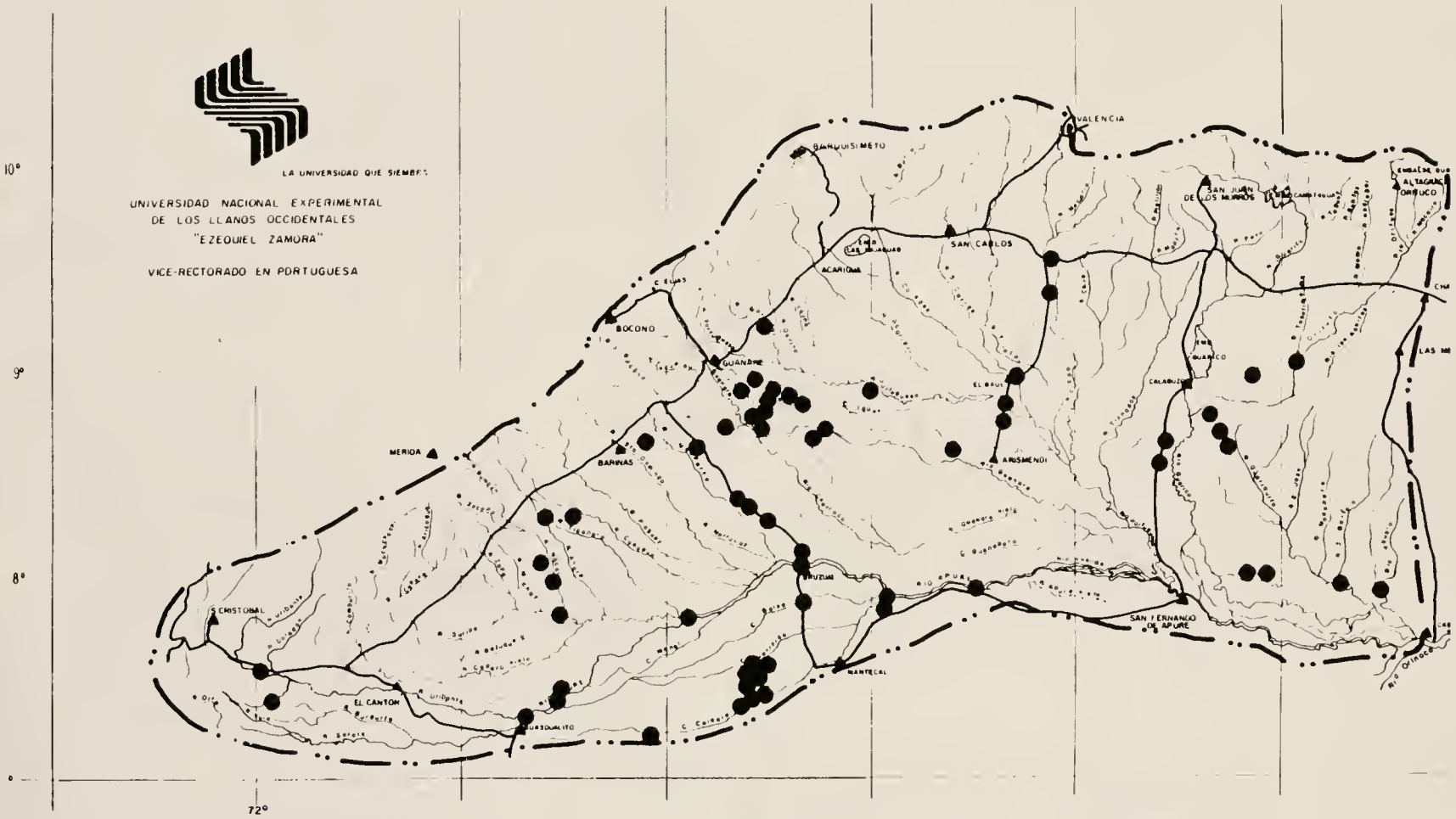
Morphology. The premaxilla has a feeble canine at either end and a double row of conical teeth between, and the dentary has two feeble canines and one series of conical teeth (Eigenmann 1912). The cleithrum has a large notch to accommodate the pectoral-fin base. The dorsal-fin origin is behind the anal-fin origin, but is nearer to the snout tip than to the base of the caudal fin. There is no ventral keel, and the breast is flat. The maxilla is longer than the eye diameter.

Counts. DR ii8-ii9; AR 43-56; VR 8; LLS 53-60; GR 8.

Measurements. GBD 32-43% SL; HL 23-24%; eye diameter equal to snout length and to interorbital width in adult, 3.7 in HL;

Pigmentation. The body is whitish or silvery in preservative, almost transparent in life, and the humeral spot is vertically elongate

Figure 99. Apure drainage distribution of *Charax gibbosus*.



CUENCA DEL RIO APURE

and farther back on the side than in similar species (over the seventh or eighth scale of the lateral line). The caudal fin has a faint vertical bar at its base.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins, and the Guianas (Géry 1977).

Apure distribution. Map: fig. 99. *Charax gibbosus* is widespread in the lower parts of the drainage.

Habitat. It is usually found in the sluggish areas of lowland creeks, swamps and other lentic habitats.

Abundance. COMMON.

Number of specimens examined. 984 from 144 collections.

Food. CARNIVORE. This species eats small fish and aquatic insects, especially Hemiptera (K. Winemiller pers. com.).

Reproduction. Strategy: r2; generation time: 6 months; fecundity: 280 eggs/female; egg diameter: 1.00 mm (Winemiller & Taphorn 1989). Eggs are scattered over aquatic vegetation and then abandoned. Incubation lasts 30 hours, and after the yolk sac is absorbed the fry feed on plankton (Axelrod et al. 1971).

Importance. Ornamental.

Cheirodon pulcher (Gill) 1858

Sardinita - Pretty Tetra

Figs. 53 (teeth) & 100. Map: fig. 101. Couplet 77a.

Generic synonymy

Cheirodon Girard 1854:199 (type species: *Cheirodon pisciculus* Girard 1854, by monotypy).

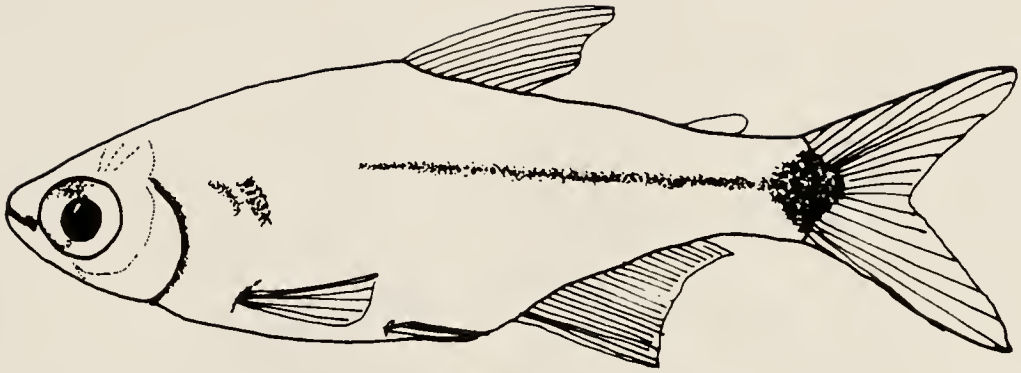


Figure 100. Cheirodon pulcher.

Chirodon Günther 1864:332 (type species: Cheirodon pisciculus Girard 1854), (alternative spelling).

Odontostilbe Cope 1870:566 (type species: Odontostilbe fugitiva Cope 1870, by monotypy).

Specific synonymy

Poecilurichthys pulcher Gill 1858:422 (type locality: Trinidad), seen.

Chirodon (Odontostilbe) pulcher Lütken 1874:238 (Venezuela?);

Odontostilbe pulcher Eigenmann 1920:9 (Maracay area, Venez.); Schultz 1944b:318 (key, Caripito, Venez.).

Odontostilbe pulchra Géry 1977:558 (key; taxonomic comments).

Comments. The question of the proper name for this genus is still unresolved. Fink & Weitzman (1974) synonymized Odontostilbe with Cheirodon, but Géry (1977) maintained the genus Odontostilbe for those forms with a complete lateral line.

Etymology. CHEIR = hand shaped, ODON = teeth. PULCHER = pretty.

Description

Illustrations. Fig. 53 (teeth) & 100; Regan 1906:pl. 22.

Diagnosis. This species can be distinguished from similar small tetras (for example Hemigrammus) by having its premaxillary teeth in a single row. The lateral line is incomplete. The very similar Cheirodontops geayi is more slender and has a smaller caudal spot, a complete lateral line, and differs markedly in dentition. Cheirodon pulcher has premaxillary teeth with nine cusps, and dentary teeth with seven. The teeth in the upper and lower jaw are essentially similar in shape, with the central cusp longest. Cheirodontops geayi, on the other hand, usually has premaxillary teeth with only five cusps, and very different dentary teeth (three flattened central cusps, and two tiny outer cusps on each tooth) see fig. 53.

Size. This is a small fish that seldom exceeds 30 mm SL.

Morphology. The dorsal fin is equidistant from the snout and the base of the tail. The maxilla extends back to the level of the front margin of the eye. There is a short sheath of scales on the anterior base of the anal fin.

Counts. DR ii9; AR iii20-iii22; PR 13; VR i7; LS 32-35; TS 11 (6 above 5 below LL). Premaxilla with 5-6 teeth, maxilla with three, dentary with seven, seven cusps on each tooth in both jaws, sometimes the teeth have black or reddish tips.

Measurements. Body depth 2.5-2.8 in SL; HL 3.7-4.7 in SL.

Pigmentation. There is distinct black spot at the base of the caudal fin that extends onto the caudal peduncle. A red, yellow or orange dot is present above (and often below as well) this. The eye is red above the pupil and there is a gold spot on and behind the opercle. A narrow lateral stripe starts at or just in front of the dorsal-fin origin. All the scales above this line are specked with pigment (concentrated posteriorly on each scale), but those below are nearly white.

Distribution and Natural History

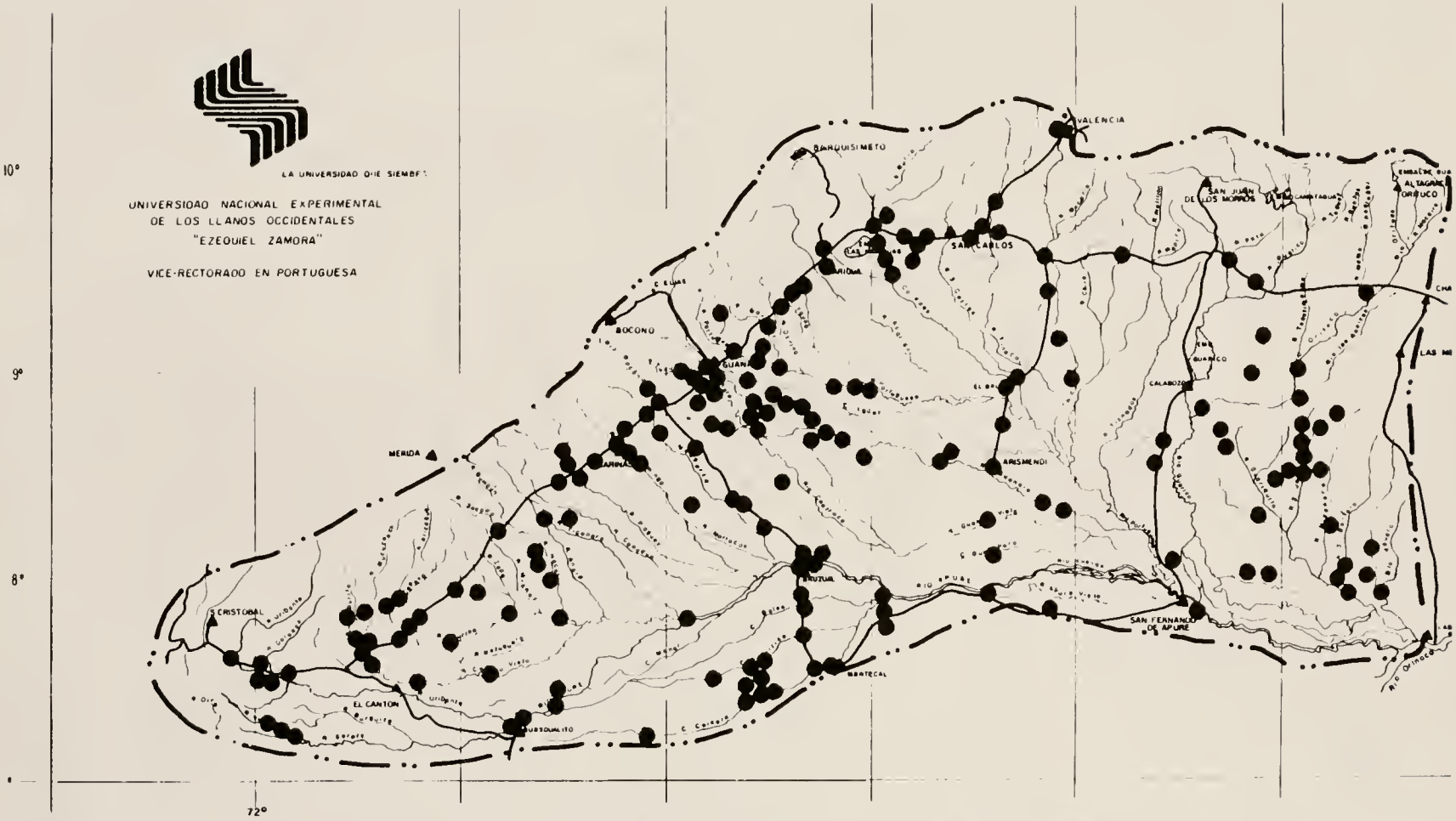
Range. This species is found from Trinidad, and the Orinoco Basin of Venezuela and Colombia.

Apure distribution. Map: fig. 101. This small tetra is ubiquitous in the piedmont and llanos.

Habitat. It occurs in almost any water body, but is more common in lowland lentic systems.

Abundance. ABUNDANT. This is the most ubiquitous species in the Apure drainage.

Figure 101. Apure drainage distribution of *Cheirodon pulcher*.



CUENCA DEL RIO APURE

Number of specimens examined. 21,330 from 431 collections.

Food. OMNIVORE. The diet of this species includes filamentous algae, microcrustaceans, protozoa, desmids and diatoms (K. Winemiller, pers. com.).

Reproduction. Strategy: rl; generation time: four months; fecundity: 1108 eggs/female; egg diameter: 0.75 (Winemiller & Taphorn 1989). These fish spawn throughout the rainy season, and individuals may spawn more than once. It is an egg scatterer.

Importance. Ornamental.

Cheirodontops geayi Schultz 1944

Sardinita - Tetra

Figs. 53 (teeth) & 102. Map: fig. 103. Couplet 77b.

Generic synonymy

Cheirodontops Schultz 1944b:319 (type species: *Cheirodontops geayi* Schultz 1944b, by original designation).

Specific synonymy

Cheirodontops geayi Schultz 1944b:319 fig. 42,43 (type Locality: Río Guárico and tributaries between San Sebastian and San Casimiro, Aragua, Venez.), seen; Mago L. 1970:70; Géry 1977:546 (key).

Types. Holotype: USNM 121507. Paratypes: CAS-SU 18144 (formerly USNM 121508).

Comments. As Schultz himself noted (1944b), the only difference between the genera *Cheirodontops* Schultz 1944b and *Holoshesthes* Eigenmann 1903 is the presence of one or two maxillary teeth in the latter. Schultz examined only seven specimens to describe the new genus. I doubt that this small difference warranted the description of a new genus.

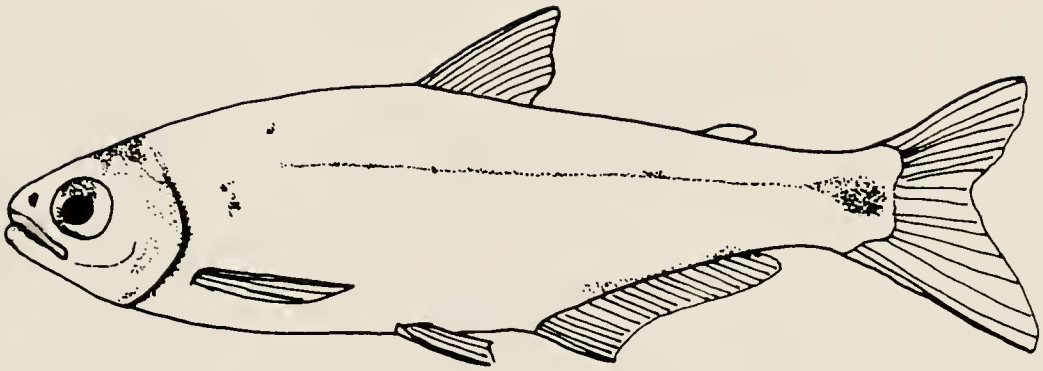


Figure 102. Cheirodontops geayi.

Etymology. CHEIRODON = Cheirodon, a related and similar genus of cheirodontine characid, OPS = like; GEAYI = after French biologist F. Geay, who reported on the fisheries of the Orinoco Basin in his work "Pêches dans les Affluentes de l'Orinoque" (Schultz 1944b).

Description

Illustrations. Figs. 53 (teeth) & 102; Schultz 1944b:320, (this figure shows the fish as much deeper bodied and stockier than most specimens I have seen).

Diagnosis. This species can be distinguished from many similar small tetras (for example Hemigrammus spp.) present in the Apure drainage by the presence of a single row of premaxillary teeth. It is similar in this respect and in overall appearance to Cheirodon pulcher, but can be distinguished by its complete lateral line, more slender body, smaller caudal spot and in particular, the very different dentition. Cheirodontops geayi have differently shaped teeth on the premaxilla and dentary. While most teeth of both jaws are pentacuspid, the outer cusps are often minute, those on the dentary have three, wide, flat central cusps, whereas those on the premaxilla have the central cusp pointed, and larger than the others. See Schultz (1944b) for a more detailed description.

Size. This fish can grow to about 50 mm SL, but most individuals are between 30-40 mm.

Morphology. The anal-fin base has a sheath of scales anteriorly.

Counts. DR ii-9; AR iii21-22, hooks present on rays in males; PR 11; VR i7; branched caudal-fin rays 17; LLS 35-37; TS 10-11, five above and four below the lateral line. Premaxillary teeth six on either side, dentary with 4 large teeth and six smaller on each side; GR 14.

Measurements. HL 4.1-4.3 in SL; GBD 3.0-3.4 in SL; EYE 3.0-3.2 in HL.

Pigmentation. The body is silvery to whitish. On the dorsum there are three rows of scales which have white centers outlined in gray. The fins have very little pigment. The caudal spot extends from the base of the central caudal-fin rays onto the caudal peduncle. The lateral stripe consists of both deep (embedded) and superficial pigment and there is also a concentration of pigment along the base of the anal fin.

Distribution and Natural History

Range. So far this species is reported only from Venezuela, in the Orinoco basin but it is undoubtedly present in the Colombian part of the basin as well.

Apure distribution. Map: fig. 103. This fish is widely distributed throughout the lower portion of the drainage.

Habitat. This fish seems to be at home in main river channels, smaller streams, and even in standing waters.

Abundance. COMMON.

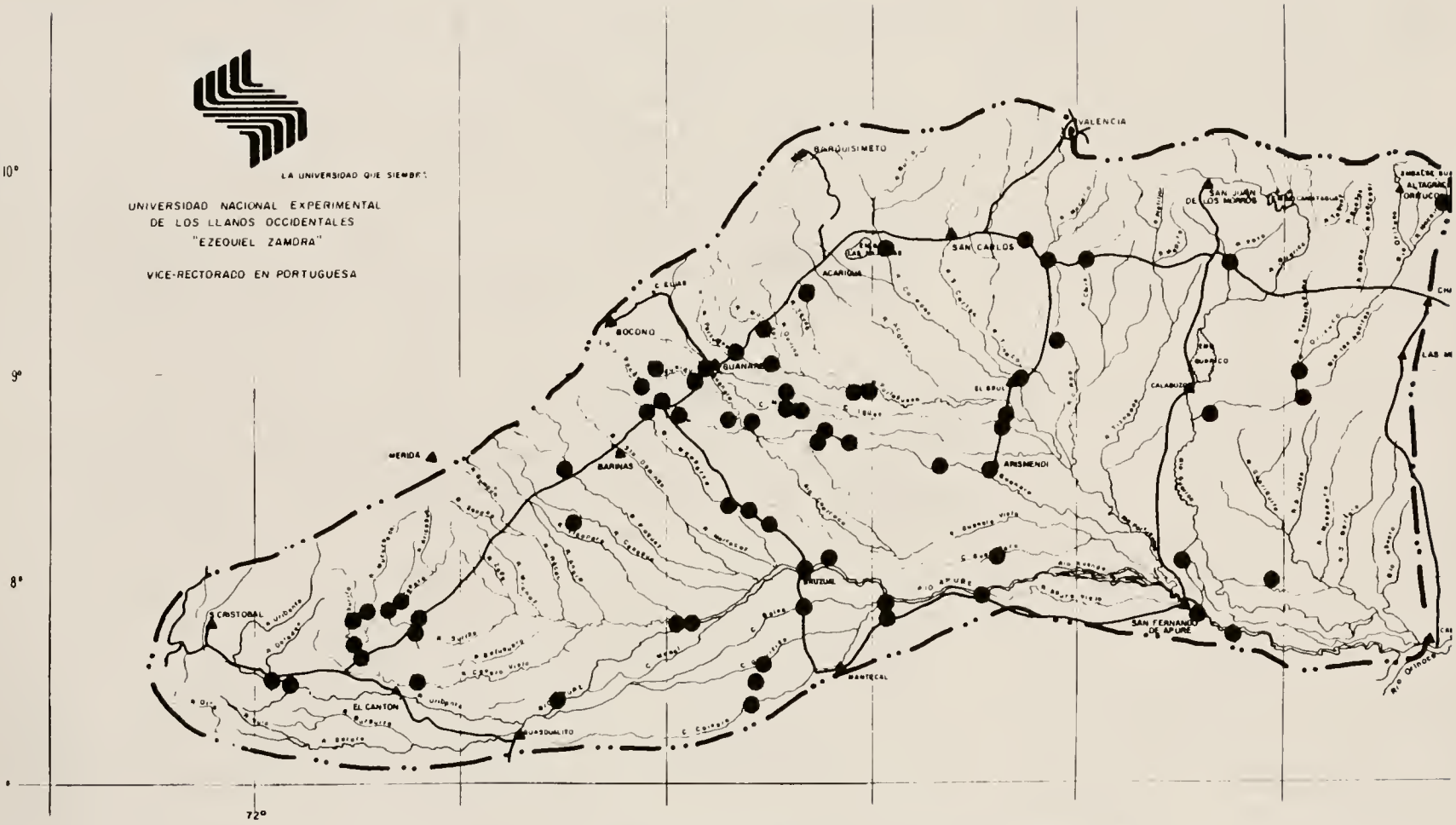
Number of specimens examined. 1,705 from 101 collections.

Food. CARNIVORE. This species feeds on microcrustaceans and aquatic insects.

Reproduction. Strategy: r2; generation time: 12 months; fecundity 1108 eggs/female; egg diameter 0.75 mm (Winemiller & Taphorn 1989). This species spawns annually at the onset of the rains. It is probably an egg scatterer with no parental care.

Importance. Ornamental, but not highly sought due to the absence of "interesting" colors.

Figure 103. Apure drainage distribution of *Cheirodontops geayi*.



CUENCA DEL RIO APURE

Colossoma macropomum (Cuvier) 1818

Cachama - Pacu

Fig. 39a (operculum) & 104. Map: None. Couplet 30a.

Generic synonymy

Colossoma Eigenmann & Kennedy 1903:350 (type species: Myletes oculus Cope 1872, by original designation).

Waiteina Fowler 1907:473 (type species: Myletes nigripinnis Cope 1878 by original designation).

Reganina Fowler 1907:475 (type species: Myletes bidens Spix in Agassiz 1829, by original designation).

Colosoma Eigenmann 1917:35. (misspelling).

Mellonina Campos 1946:219 (type species: Mellonina tambaqui Campos 1946, by original designation).

Specific synonymy

Myletes macropomus Cuvier 1818:453, pl. 22 fig. 3 (type locality: Brazil), seen; Valenciennes in Cuvier & Valenciennes 1849:(146)195 (redescription of type); Peters 1877:473 (Apure River, Venez.); Eigenmann & Eigenmann 1891:61.

Myletes bidens (not of Spix) Castelnau 1855:68 pl. 35 fig 1-3.

Salmo tambaqui Natterer in Kner 1860:21 (mentioned in text).

Myletes oculus Cope 1872:268, pl. 12 fig. 3 (type locality: Ampiyaco, Peru).

Myletes nigripinnis Cope 1878:693 (type locality: Peru, Pebas, Nauta); Steindachner 1882:125 pl. 7, fig. 1 (redescription).

Colossoma oculus Eigenmann & Kennedy 1903:530 (new generic name for Myletes oculus Cope 1872); Fowler 1906:472 (redescription); Norman 1929:811 (redescription, synonymy, Peru).

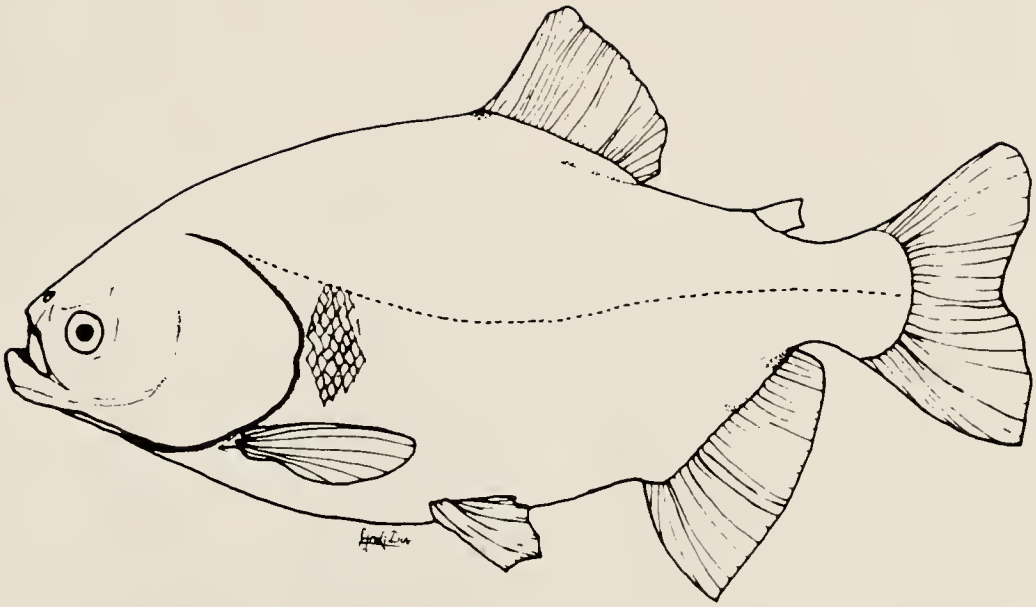


Figure 104. Colossoma macropomum.

Colossoma (Waiteina) nigripinnis Fowler 1906:473.

Colossoma nigripinnis Norman 1929:808 (key, synonymy).

Piaractus macropomus Eigenmann 1910:443 (R. Orinoco); Román 1985:113 (description, Venez.).

Piaractus nigripinnis Eigenmann 1915a:262 (redescription); Eigenmann & Allen 1942:247.

Colossoma macropomus Norman 1929:808 (key, synonymy); Schultz 1944b:255; Fowler 1950; Mago L. 1970:70.

Mellonina tambaqui Campos 1946:219 fig. 3 (type locality: ?Brazil).

Colossoma (Piaractus) brachypomum Géry 1977:255.

Colossoma macropomum Machado A. 1982: (diagnosis, description, synonymy).

Types. Holotype: MNHN A.8627.

Etymology. COLOS = without horns (that is, lacking a predorsal spine, as is present in many serrasalmines), SOMA = body; MACRO = large, POMUM = cheek, referring to the large, wide operculum.

Description

Illustrations. Fig. 39a (operculum) & 104; Géry 1977:255; Novoa et al. 1982: 269, fig. 6; Machado A. 1982: (photos of holotype and juveniles); Román 1985:113.

Diagnosis. There are only two species of cachamas known in the Apure drainage. C. macropomum is distinguished from Piaractus brachypomus in having a wider operculum (see fig. 39a), fewer lateral-line scales (67-76 vs 78-90), fewer scales between the dorsal-fin origin and the lateral line (19-23 vs 26-30) and by the presence of ossified rays in the adipose fin of specimens larger than 55 mm SL.

Size. Specimens measuring 920 mm TL and weighing 18 kg have been reported from the Orinoco Delta (Novoa et al. 1982).

Morphology. This is a giant characid, with a heavy set, discoid body. See Machado A. (1982) for a detailed account.

Counts. DR ii-iv13-14 (15-18); AR ii-iv21-24 (24-28); PR i15-18 (16-19); VR i7; caudal fin i-9+8-i; LLS 66-78; TS 16-23 above LL, 19-27 below LL; GR vary with size from about 20 in a specimen of 19 mm SL to 136 in a large adult of 755 mm SL (Machado A. 1982).

Measurements. GBD 45.0-67.6% SL; HL 34.4-51.9% SL (Machado A. 1982).

Pigmentation. Juveniles up to 30 mm SL have a series of irregular spots over a yellowish background, with a large ocellus on the rear half of the flank, and a reddish head. The caudal-fin is edged in black and the anal fin is orange with a black border. The other fins are mostly transparent. As the fish grow, the base color darkens and the ocellus and irregular spots are lost. The fins eventually darken to black. Adults have the ventral region dark or black, the lateral and dorsal regions olivaceous or copper-colored, and the fins black (Machado A. 1982).

Goulding (1980) noted that this species is countershaded in Amazonian waters, but backwards relative to most fishes. It is lighter above and darker below. The colors of specimens taken from blackwater streams are more intense.

Novoa et al. (1982) reported two different color morphs present in the Orinoco Delta area. In one the dorsum is yellow and the ventrum white; in the other, the fish is mostly black with a whitish belly. I have observed more dark-colored fish in the Apure markets, with a generally black coloration that is most intense on the pectoral fins, lower sides, anal fins, lower caudal peduncle and tail. The belly is whitish.

Distribution and Natural History

Range. It occurs in the Orinoco and Amazon basins.

Apure distribution. Map: None. No specimens were obtained during this study, mainly because commercial seining gear or hook and line are usually necessary to catch them. It is (or was until recently) fairly common in most of the larger rivers.

Habitat. In the Apure drainage, this species is caught mostly in the main channels of large rivers during migrations, and in larger llaneran creeks during the dry season. The cachama fishery is endangered because of the loss of habitat due to increased drainage of flooded forests, dikes that prevent access to the floodplain, the continuous loss of the gallery forests that once provided the fruits and seeds essential to its survival, and the overfishing of ripe females during the dry season.

Abundance. COMMON.

Food. HERBIVORE. This species eats large seeds, fruit, flowers, aquatic vegetation. Goulding (1980) noted that their fine gillrakers are used to trap plankton when young. Adults use massive dentition to crush large heavy seeds, such as those of the rubber tree *Hevea* and the palm *Astrocaryum*. These trees are widely distributed in the Amazon basin and produce large, numerous, high protein seeds which are too big or hard for most other species to eat. The cachamas actively seek out trees in fruit. When food becomes scarce during low water, their diet increases in variety of foods eaten. Thus, a dietary specialization is in effect mainly during the "good" period of the year when food is abundant, not during the times of scarcity as some authors have suggested.

Reproduction. Strategy: r2. Gonads ripen during the dry season and mating is synchronous with the onset of the rains in May to June. Novoa et al. (1982) reported that cachamas in the Orinoco Delta area move onto the inundated floodplains to spawn in the shallows. Fry stay in the aquatic vegetation where they grow quickly, feeding on plankton and algae. At the end of their first wet season, young fishes move from the floodplain back into regular watercourses. Fecundity is very high; the largest females can produce around one million eggs each year.

Migrations. Extensive migrations are known to occur, but different regions have different movement patterns. In the Apure drainage, fish tend to move upstream in the dry season, and back down with the rains.

Importance. This is an extremely important species in the commercial fishery, and of growing importance in fish culture. It is usually captured with large meshed seines operated from two dugout canoes with outboard motors or (much less frequently) with gill nets.

Corynopoma riisei Gill 1858

Sardinita Cachete de Espada - Sword-Cheeked Tetra

Fig. 105. Map: fig. 106. Couplet 2a.

Generic synonymy

Corynopoma Gill 1858:65 (type species: *Corynopoma riisei* Gill 1858, by original designation); Regan 1906:382.

Stewardia Gill 1858:63 (type species: *Stewardia albipinnis* Gill 1858, by original designation); Eigenmann 1914:37.

Nematopoma Gill 1858:68 (type species: *Nematopoma searlesii* Gill 1858, by original designation).

Specific synonymy

Corynopoma riisei Gill 1858:66 (type locality: Trinidad), seen;

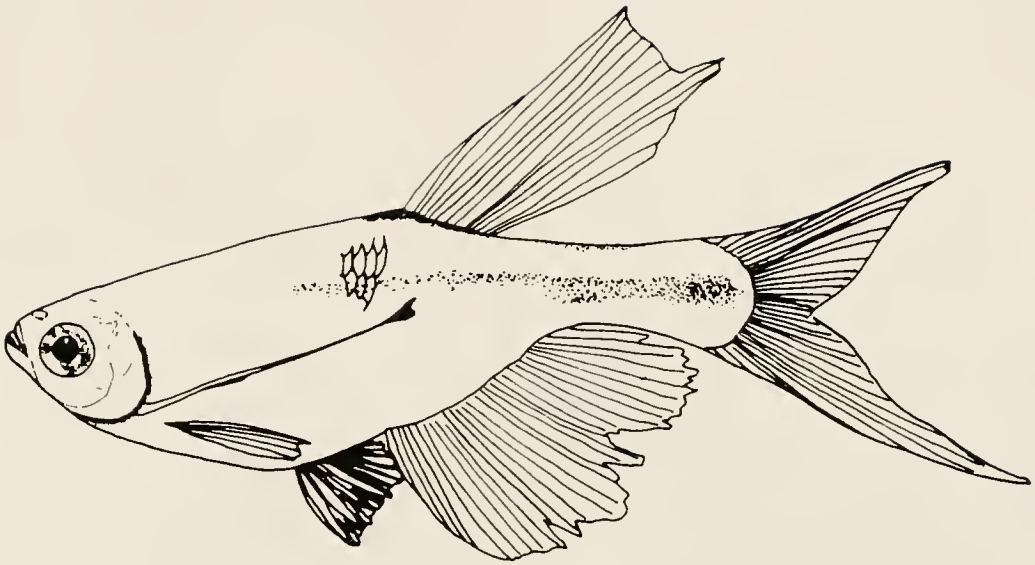


Figure 105. Corynopoma riisei.

Eigenmann & Myers 1929:470 (key, description); Regan 1906:382 (redescription); Axelrod et al. 1971:F-225.00; Mago L. 1970:70; Géry 1977:356 (key); Richter 1986:44 (spawning).

Stewardia albipinnis Gill 1858:65 (type locality: Trinidad).

Corynopoma albipinne Günther 1864:287.

Corynopoma veedonii Gill 1858:67 (type locality: Trinidad).

Nematopoma searlesii Gill 1858:69 (type locality: Trinidad).

Corynopoma searlesii Günther 1864:288; Lütken 1874:222 (Trinidad).

Stewardia aliata Eigenmann 1914:37 (type locality: base of Andes east of Bogotá); 1922:238.

Corynopoma aliata Eigenmann & Myers 1929:468 (key, description).

Etymology. CORYNO = spatula, POMA = cheek or operculum, meaning "with a spatula attached to the gill plate"; RIISEI = after Mr. A. H. Riise, a Danish zoologist who worked in the West Indies.

Description

Illustrations. Fig. 105; Regan 1906:pl. 22; Axelrod et al. 1971:F-225.00; Géry 1977:356, 357; Mago L. 1978:9; Richter 1986:44-5, 48-9.

Diagnosis. This fish strongly resembles Gephyrocharax valenciae, with which it is frequently sympatric, but differs in lacking an adipose fin. The strange filamentous extension of the opercle in males of this species is unique among Venezuelan characids, although similar structures have been described for Pterobrycon, a Central American glandulocaudine characid (Bussing 1971).

Size. Males grow to about 75 mm TL, but females are smaller.

Morphology. The mouth is superior, with the lower jaw extending beyond the upper. The nostrils are near the antero-dorsal corner of

eye. The lateral line is initially deflected downward after which it continues straight to the base of the caudal fin. The dorsal fin is placed well back, with its origin over the middle of the anal-fin base. The caudal fin is deeply forked.

Counts. DR 8; AR 27; PR 10; VR 6.

Pigmentation. This is a silver-bodied to pinkish fish with clear fins. There is a faint horizontal stripe that is most intense and widest on the caudal peduncle. The tip of the opercular "paddle" is shiny.

Distribution and Natural History

Range. It occurs in Trinidad, and in the Venezuelan and Colombian Andes.

Apure distribution. Map: fig. 106. This species is strictly limited to the Andean piedmont.

Habitat. This fish inhabits shady, shallow, slow-moving streams of the Andean piedmont.

Abundance. COMMON.

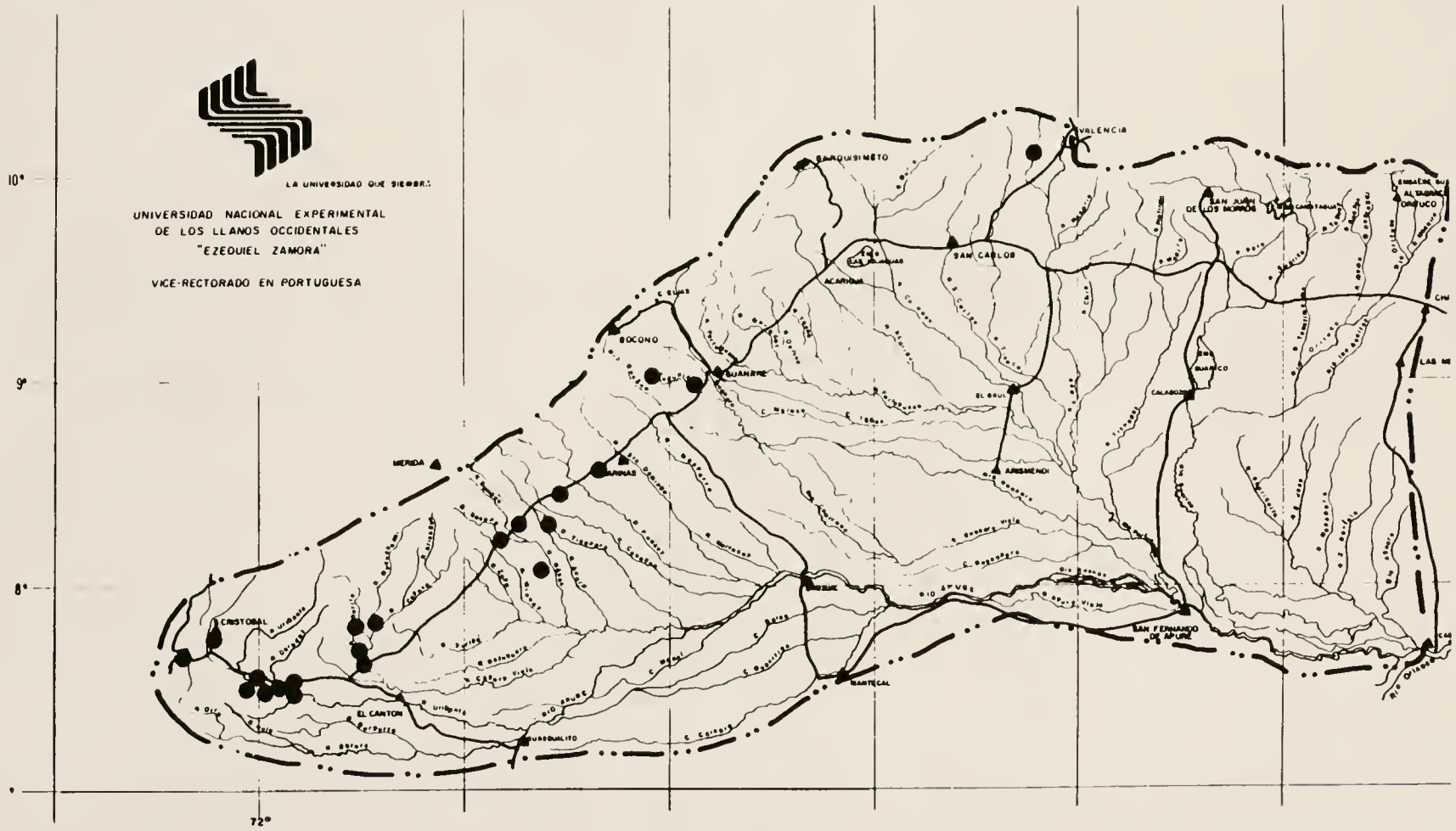
Number of specimens examined. 362 from 28 collections.

Food. CARNIVORE. It feeds mostly on terrestrial insects, especially ants (K. Winemiller pers. com.)

Reproduction. Strategy: rl; generation time: 4 months; fecundity: 135 eggs/female; egg diameter 0.85 mm (Winemiller & Taphorn 1989). Individuals spawn repeatedly throughout most of the year.

The courtship ritual is elaborate, with much display activity by the male. Fertilization is internal, but the mechanics by which this is effected is as yet unexplained. The male wraps his anal fin around the female to form a pocket as he expels the sperm, but the female does not expel the eggs at that time. She will later place the embryos in

Figure 106. Apure drainage distribution of *Corynopoma riisei*.



CUENCA DEL RIO APURE

aquatic vegetation. They hatch in about 30 hours, and are free-swimming after about 4 days, when they will start to feed on plankton (Richter 1986). Dr. Stanley Weitzman (pers. com.) has studied the reproductive habits of this and other glandulocaudines. He believes that the "tail beat" movements of the courtship dance may direct the pheromone produced in the caudal glands towards the female and that the enlarged, modified scales on the caudal fin base of males may act as pumps for the pheromone. During the nuptial dance, the female nips at the opercular "paddles." This may polarize her attention sufficiently for the male to fertilize her.

Importance. Ornamental.

Creagrutus cf beni Eigenmann 1911

Dientefrio - Buck-Toothed Tetra

Figs. 40 (humeral spot) & 107. Map: fig. 108. Couplet 37b.

Generic synonymy

Creagrutus Günther 1864:339 (type species: Leporinus muelleri Günther 1859:90, by monotypy).

Specific synonymy

Creagrutus beni Eigenmann 1911:172, pl. 6, fig. 2 (type locality: Villa Bella, Bolivia, Río Beni into Río Madeira [a southern tributary of the Amazon River]), seen; Eigenmann 1918:pl. 93, figs. 4, 5, 7; 1920:12 (Maracay, Valencia and Caracas, Venez.); 1927:421 (Valencia, Venez.); Pearse 1920:20,43 (Valencia, Venez.); Fowler 1931:408 (Yarapa River, Venez.); 1940:100; 1942:128; 1945a:148; 1945b:102; 1948:83 (synonymy, range); Schultz 1944b: (Maracaibo Basin, Río Tuy in Caracas, and Caripito, Venez.); Mago L. 1970:70; Géry 1977:392, 407, 410.

Types. Holotype: FMNH 54585, (formerly CM 3216), examined.

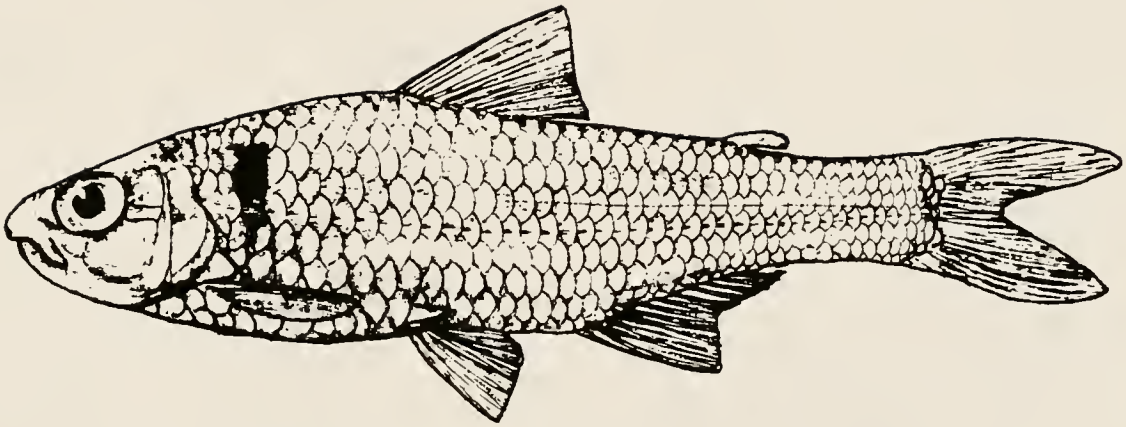


Figure 107. Creagrutus cf beni.

Comments. The holotype of C. beni, FMNH 54585, from Bolivia, is in poor condition based on my examination. Eigenmann's photo (1911) of the holotype shows a vertically elongated humeral bar, very different from the concentrated spot or blotch observed in Venezuelan specimens from the Apure drainage. I am convinced that the Venezuelan form represents a different species. A Bolivian specimen, FMNH 77395, has a crescent-shaped humeral spot, something almost never seen in Venezuelan "C. beni."

Etymology. CREA = flesh, from the Greek, GRUTUS = to tear, also Greek; BENI = for the river in Bolivia of the same name, type locality for this species.

Description

Illustrations. Figs. 40 (humeral spot) & 107; Eigenmann 1911:pl. 6, fig.2; 1918:pl. 93 fig. 7 (photo).

Diagnosis. Members of the genus Creagrutus can be distinguished from most other tetras in the Apure drainage by their prominent, projecting upper jaws, and in possessing three (versus one or two) rows of teeth on the premaxilla. Creagrutus cf beni has a rounded humeral spot instead of a crescent-shaped one, as observed in C. bolivari. It is distinguished from Creagrutus n. sp. in having fewer scales between the lateral line and the dorsal-fin origin (five vs six), and in usually lacking the dark black pigment seen in the central area of the dorsal fin of that species.

Size. This fish can grow to about 60 mm SL, but most individuals are between 30-50 mm SL.

Morphology. The dorsal-fin origin is behind or over the pelvic-fin origin. The lateral line is complete.

Counts. DR 10; AR iii10-iii12; LLS 35-40.

Measurements. HL 3 1/3 - 4 in SL; GBD 3 - 3 1/2.

Pigmentation. The humeral spot is rounded and not shaped like an open vertically elongate crescent (although the rounded spot sometimes can take the form of a tight, closed crescent). Usually there is a concentration of pigment near the lateral line if vertical extensions of the humeral spot are present. The body is pinkish in life, with a dark lateral stripe. The dorsum does not have a complete line of darker scales down the midline. There is no spot on the caudal peduncle.

Distribution and Natural History

Range. Although this species is reported from the Andean headwaters of the southern Amazon basin in Bolivia, northward to the Maracaibo basin and the Orinoco basin in Venezuela, I suspect that several similar species are involved.

Apure distribution. Map: fig. 108. This fish is restricted to streams and rivers in the Andean mountains and piedmont.

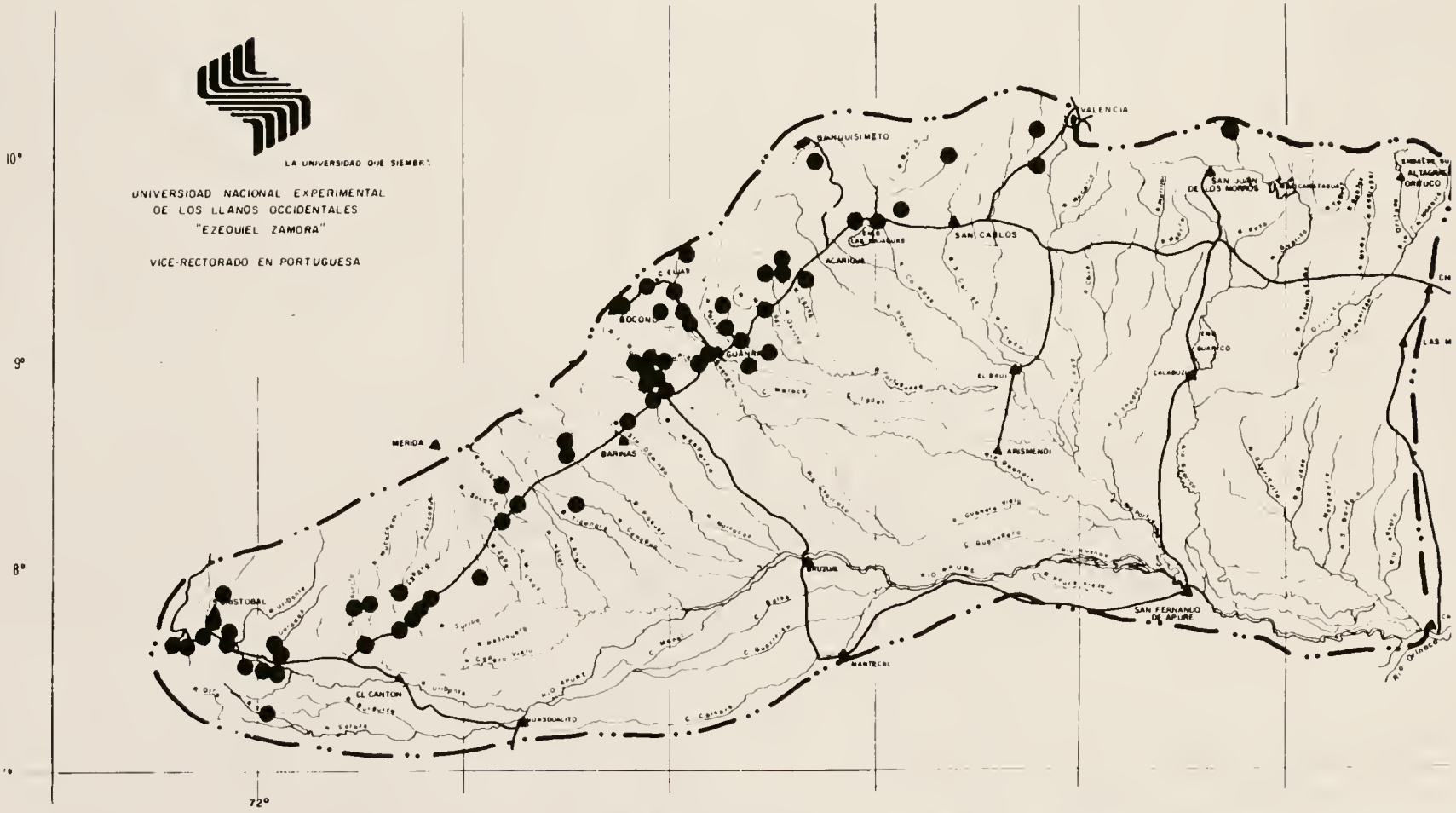
Habitat. *C. beni* is found in piedmont and montane streams throughout the Andes, in swiftly flowing waters over rocky substrates.

Abundance. COMMON.

Number of specimens examined. 1,315 from 87 collections.

Food. Benthic OMNIVORE. It feeds mostly on aquatic insects, and small seeds (K. Winemiller pers. com.), but Pearse (1920) reported a diet of 96.2% (volume) snails and 3.8% midge pupae from Lake Valencia. I have observed them feeding in the pools and quieter stretches of rapids where they usually are observed near the bottom in small groups feeding on detritus, items rolling down in the current, and aquatic insects. *C. beni* is extremely active, and always on the go.

Figure 108. Apure drainage distribution of *Creagrutus* cf *beni*.



CUENCA DEL RIO APURE

Reproduction. Strategy: probably r1. Hoedeman (1975) stated that fertilization is internal, but I have not observed any specialized structures in males that might be uses to accomplish this. In aquaria, eggs are laid among fine-leaved plants and hatch in about one day at 25°C. After three days in the yolk-sac stage, the fry begin to feed on plankton.

Importance. Ornamental.

Creagrutus bolivari Schultz 1944

Dientefrio - Buck-Toothed Tetra

Figs. 40b & 109. Map: fig. 110. Couplet 37a.

Specific synonymy

Creagrutus bolivari Schultz 1944b:334, fig. 49 (type locality: Río Guárico and tributaries between San Sebastian and San Casimiro, State of Aragua, Venezuela), seen; Myers & Roberts 1967:248; Mago L. 1970:70; Géry 1977:403,406 (key).

Comments. Based on observations by Myers and Roberts (1967), Mago L. (1970) stated that this species is probably a junior synonym of C. phasma. It is also similar to C. melanzonus Eigenmann 1912, (I examined the holotype FMNH 52705), but that has a small caudal spot. I believe that the species of Creagrutus species will eventually prove to be fairly restricted in distribution once a thorough revision of the genus is completed. Because the habitats are so different, a more detailed comparison of material from Andean streams with that from the Aguaro River system should be undertaken in order to establish if these two populations represent but a single species.

Etymology. BOLIVARI = after Simon Bolivar, liberator of northern South America.

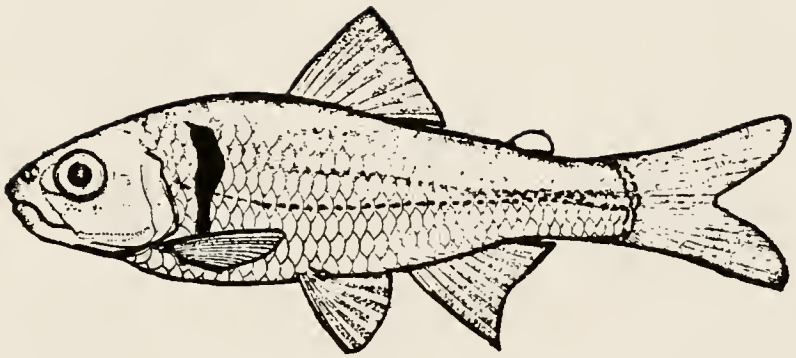


Figure 109. Creagrutus bolivari.

Description

Illustrations. Figs. 40b (humeral crescent) & 109; Schultz 1944b:335 fig. 49.

Diagnosis. see previous account of C. cf beni.

Size. This fish grows to about 60 mm SL.

Morphology. The dorsal-fin origin is over or in front of the pelvic-fin insertion. The lateral line is complete.

Counts. DR ii8; AR ii-iii8, ii-iii10, but usually iii9; PR i11-i14; VR i7; LLS 37-38; TS 5 above LL, 3 below; PDS 9.

Measurements. HL 3 2/3 - 4 in SL; GBD 3 1/3 - 4; width of second suborbital about 2/3 of eye diameter.

Pigmentation. The humeral spot is vertically elongate and crescent-shaped. The lateral stripe does not continue onto the caudal fin, and there is no caudal spot. The dorsum has a few rows of dark spots along the dorsal midline that contrast with the whitish upper sides. The paired fins are plain.

Distribution and Natural History

Range. Orinoco Basin.

Apure distribution. Map: fig. 110. This species is widespread.

Habitat. C. bolivari occurs in flowing waters of the piedmont and llanos, usually over rocky substrates.

Abundance. COMMON.

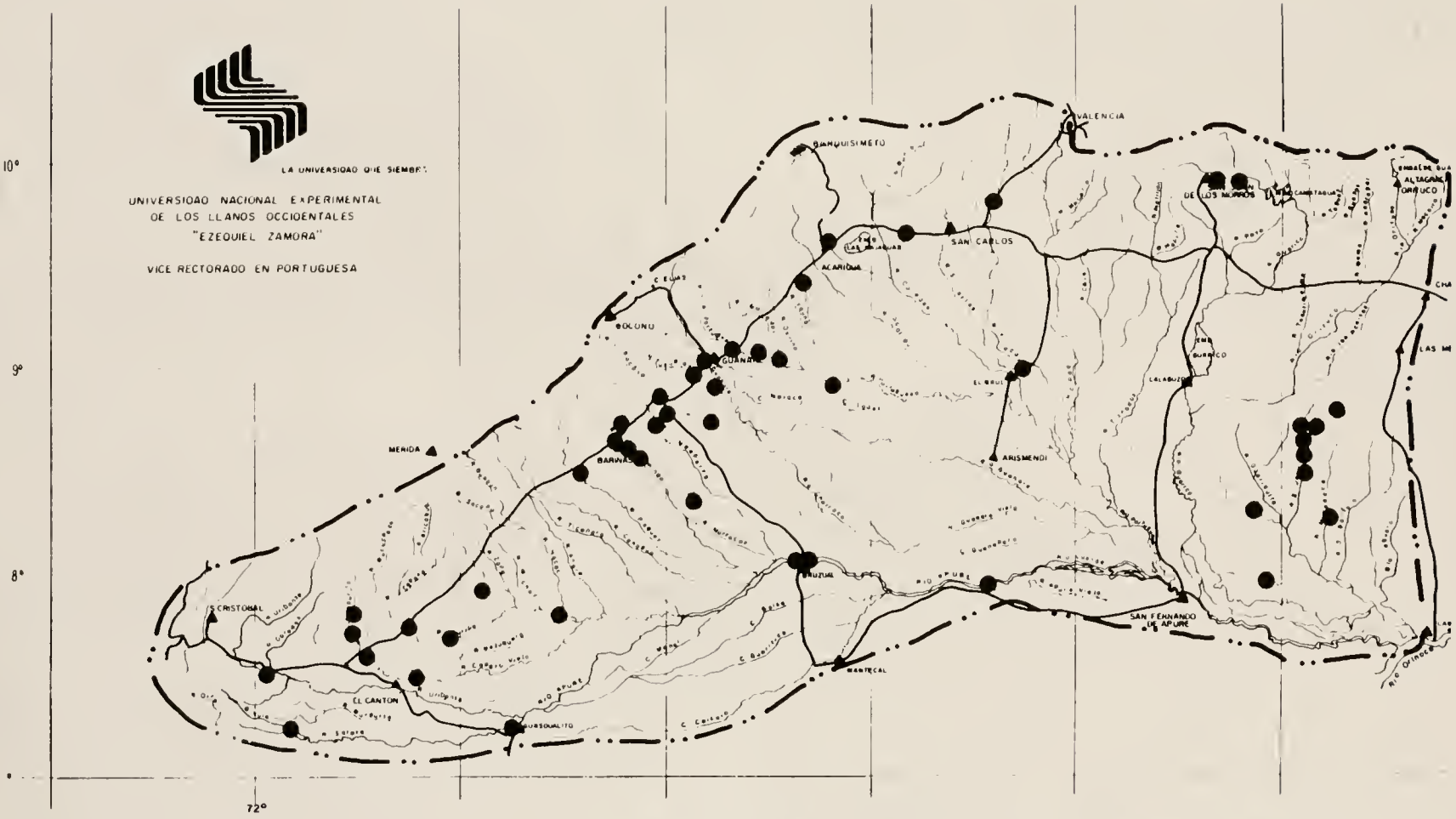
Number of specimens examined. 759 from 71 collections.

Food. OMNIVORE. C. bolivari feeds on small benthic organisms and those that drift down with the current.

Reproduction. Strategy: probably r1. Breeding probably occurs throughout the rainy season.

Importance. Ornamental.

Figure 110. Apure drainage distribution of *Creagrutus bolivari*.



CUENCA DEL RIO APURE

Creagrutus n. sp.

Dientefrio Pintada - Red-Finned Buck-Toothed Tetra

Fig. 111. Map: fig. 112. Couplet 36a.

Comments. This is probably a new species.

Description

Illustrations. Fig. 111; Géry 1977:392 (bottom photo); Román 1985:170.

Diagnosis. See account of C. cf beni. In addition, this species has distinctive colors in life. The dorsal fin and anal fin have patches of cherry-red anteriorly, and black pigment centrally. The upper lobe of the caudal fin is also red.

Size. This is a relatively small Creagrutus that can grow to about 50 mm SL, but most individuals are between 25-35 mm.

Morphology. The dorsal-fin origin is over the pelvic-fin insertions. The lateral line is complete.

Counts. DR 10; AR iii10-11; LLS 35; PDS 11.

Measurements. Body depth 2.9-3.3 in SL.

Pigmentation. In addition to the characters mentioned in the diagnosis, this species has a lateral stripe that begins under the dorsal fin and intensifies posteriorly. The humeral spot is vertically elongate. The belly is whitish.

Distribution and Natural History

Range. It probably occurs in both Venezuela and Colombia in the Andean piedmont of the Orinoco Basin.

Apure distribution. Map: fig. 112. This species is restricted to piedmont and montane stream.

Habitat. It lives in small, shallow, shady streams in the Andean piedmont that usually have clear water and a sandy or gravel substrate.

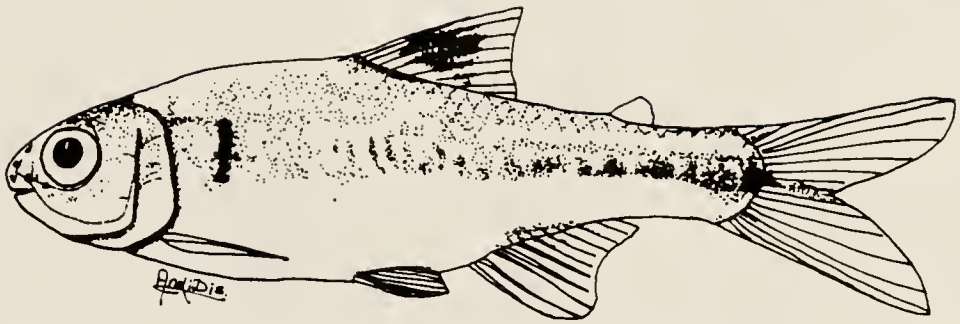
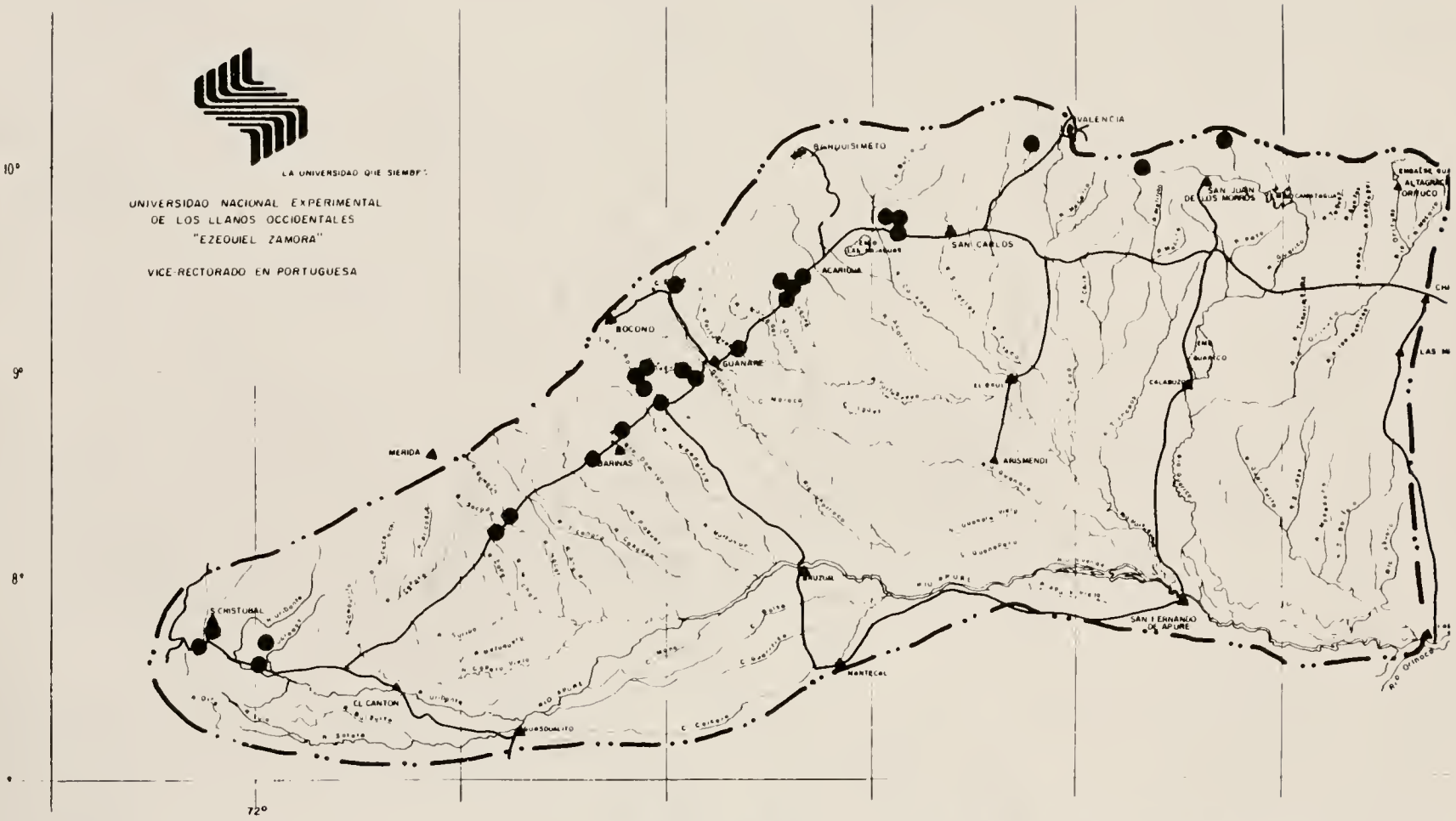


Figure 111. Creagrutus n. sp.

Figure 112. Apure drainage distribution of Creagrutus n. sp.


LA UNIVERSIDAD QUE SIEMBRA
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
GUANARE
BARINAS
MERIDA
ARAUCA
SAN JUAN DE LOS MORROS
CALABOZO
ARAUSMENDI
EL SOCO
MUCUCHIES
SAN CRISTOBAL
EL CANTON
GUASDUALITO
MONTECAL
SAN FERNANDO DE APURE
RIO APURE
RIO ORINOCO
ALTAGRACIA ORITUCO
LAS M
CUENCA DEL RIO APURE
0 Km
100
200
ESCALA GRAFICA

Abundance. COMMON.

Number of specimens examined. 575 from 33 collections.

Food. OMNIVORE. This species feeds on tiny seeds and aquatic insects (especially chironomid larvae) (K. Winemiller, pers. com.).

Reproduction. Strategy: r1; generation time: four months; fecundity: 94 eggs/female; egg diameter: 0.80 (Winemiller & Taphorn 1989). It spawns throughout the wet season. Individuals probably spawn more than once a season.

Importance. This strikingly colored species has great potential as an ornamental fish. It is quite hardy in the aquarium.

Ctenobrycon spilurus (Valenciennes) 1849

Sardinita Plateada - Silver Tetra

Fig. 113. Map: fig. 114. Couplets 10a & 40a.

Generic synonymy

Ctenobrycon Eigenmann 1908:94 (type species: Tetragonopterus hauxwellianus Cope 1870:560, by original designation).

Apodastyanax Fowler 1911:422 (type species: Apodastyanax stewardsoni Fowler 1911:422, by original designation).

Specific synonymy

Tetragonopterus spilurus Valenciennes in Cuvier & Valenciennes 1849:156 (type locality: Surinam).

Apodastyanax stewardsoni Fowler 1911:422 (type locality: Corisal, Venez.).

Ctenobrycon spilurus Eigenmann 1910:435; 1912:363; 1927:335 (Surinam to Venezuela); Mago L. 1970:70; Géry 1977:413,431 (key).

Etymology. CTENO = rough scaled, BRYCON = Brycon, a genus of characid; SPIL= spot, URUS = tail.

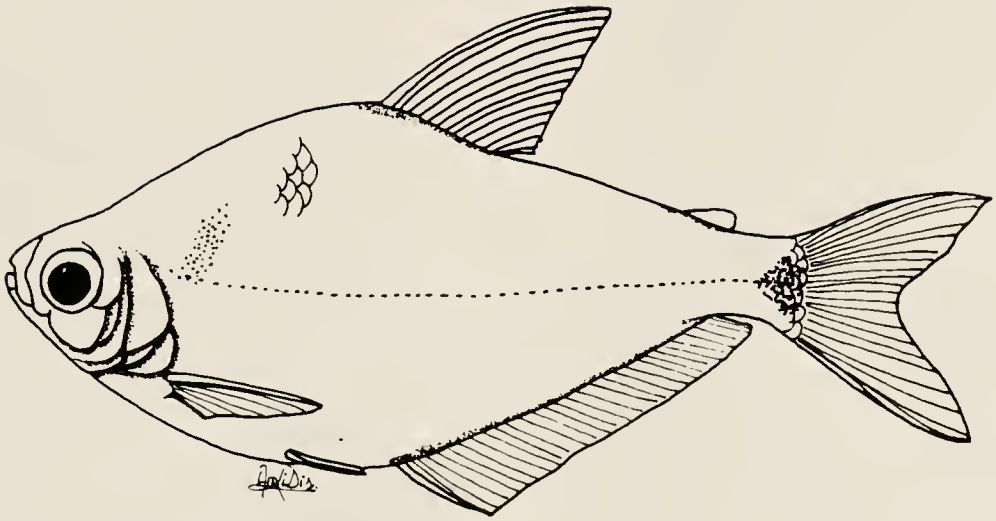


Figure 113. Ctenobrycon spilurus.

Description

Illustrations. Fig. 113; Eigenmann 1912:pl. 47, fig. 1; Axelrod et al. 1971:F-233.00; Géry 1977:413.

Diagnosis. This species is distinguished by the following combination of characters: ctenoid scales, especially obvious on the breast; a naked caudal-fin, usually with a black spot near its base; a double row of teeth on the premaxilla, a complete lateral line, and a relatively high anal-fin ray count (about iii37).

Size. It can grow to about 75 mm, but most individuals are smaller.

Morphology. The swim bladder is two-chambered, with the anterior shorter and rounded.

Counts. DR ii9; AR iv37; PR i12; VR i7; LLS 45; TS 21, 10 above and 10 below lateral line from dorsal origin to pelvic origin; GR 12-14.

Measurements. GBD 3.2-3.5 in SL; HL 3.8-4.0 in SL.

Pigmentation. This fish is plain silvery to whitish with an olive-green or sometimes golden sheen. The humeral and caudal spots are variable, but usually the caudal spot is stronger. The fins are transparent. The peritoneum is silver towards the ventrum, but pigmented dorsally.

Distribution and Natural History

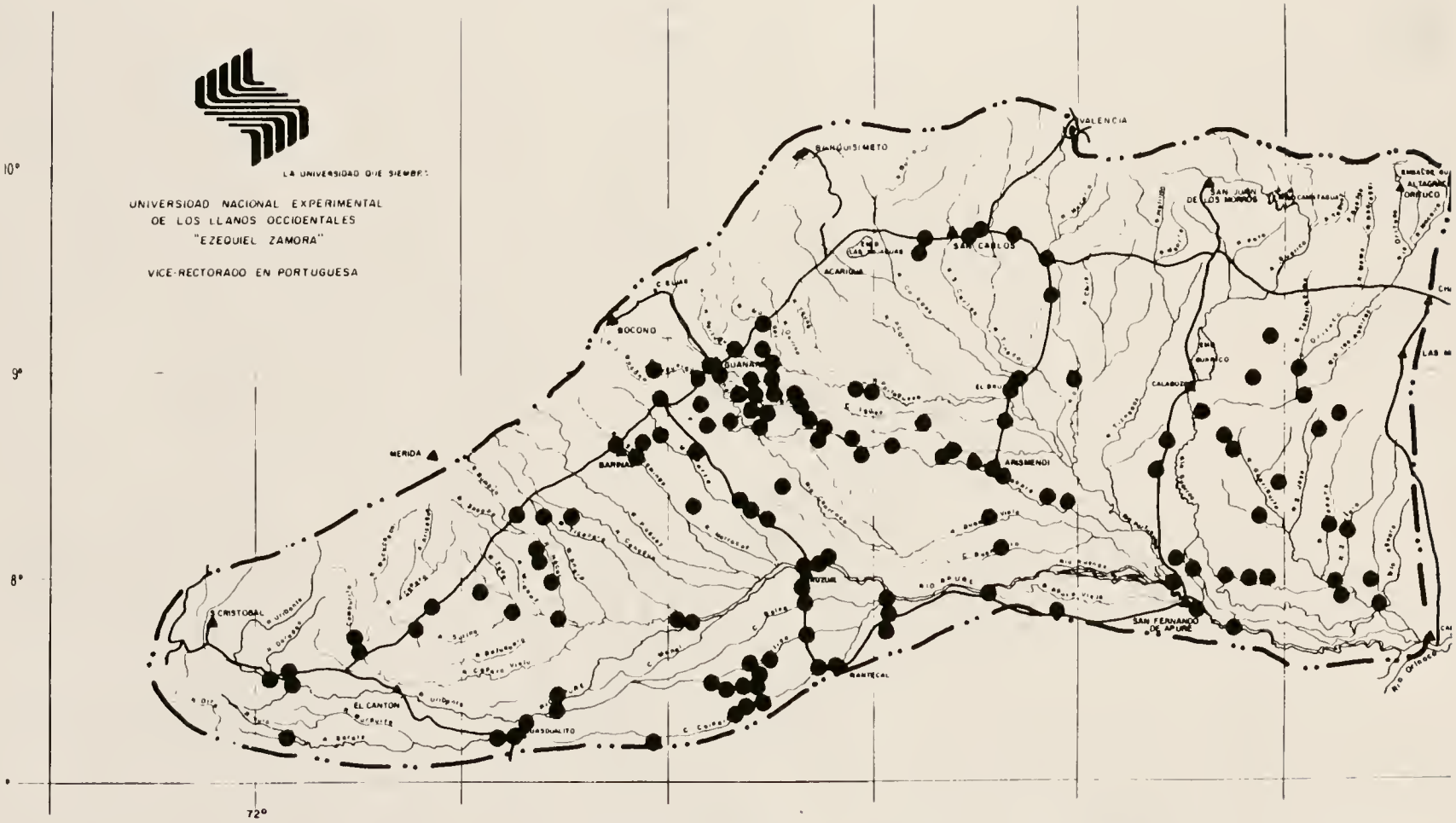
Range. It occurs in Surinam, Guyana and Venezuela (in the Orinoco Basin).

Apure distribution. Map: fig. 114. This species is widespread and common throughout the piedmont and llanos.

Habitat. *C. spilurus* favors lentic habitats such as prestamos, bajios and esteros, but is also found in slow-moving streams.

Abundance. ABUNDANT.

Figure 114. Apure drainage distribution of *Ctenobrycon spilurus*.



CUENCA DEL RIO APURE

Number of specimens examined. 16,691 from 355 collections.

Food. OMNIVORE. It eats seeds and aquatic insects.

Reproduction. Strategy: r1; generation time: 11 months; fecundity: on the average about 755 eggs/female but up to 2,000; egg diameter: 0.75 mm (Winemiller & Taphorn 1989). Spawning occurs during the first two months of the rainy season. Individuals may spawn more than once per season. Eggs are scattered among vegetation, and then abandoned. Fry hatch within 50-70 hours, remain inactive while they absorb the yolk-sac for 2-3 more days and then begin to feed on plankton.

Importance. It is quite peaceful and hardy in aquaria.

Cynopotamus bipunctatus Pellegrin 1909

Dientón

Fig. 115. Map: fig. 116. Couplet 41a.

Generic synonymy

Cynopotamus Valenciennes 1849:316 (type species: Hydrocyon argenteum Valenciennes 1849), by original designation; Eigenmann 1912:403.

Cyrtocharax Fowler 1907:454 (type species: Anacyrtus limaesquamis, by original designation); Cope 1878:686.

Hybocharax Géry & Vu-Tan-Tue 1963b:240 (type species: Cynopotamus bipunctatus Pellegrin 1909:13, by original designation).

Specific synonymy

Cynopotamus bipunctatus Pellegrin 1909:13 (type locality: mouth of the Río Suripá, Venez.); Géry & Vu-Tan-Tue 1963a:150; Menézes 1976:31 (redescription of unique holotype, key).

?Anacyrtus humeralis Pellegrin 1899 (Apure River, Venez.), (this may have been based on specimens of Galeocharax).

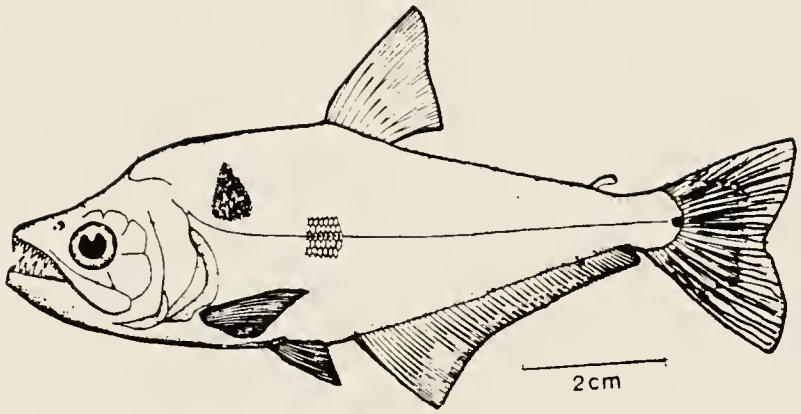


Figure 115. Cynopotamus bipunctatus. From Menézes (1976).

Cynopotamus humeralis Schultz 1944b:296.

Cyrtocharax bipunctatus Schultz 1950:62.

Cynopotamus (Hybocharax) bipunctatus Géry & Vu-Tan-Tue 1963b:241 (key); Mago L. 1970:70.

Etymology. CYNO = wolf, referring to the large canine teeth characteristic of this species, POTAMUS = of the river; BI = two; PUNCTATUS = spotted.

Description

Illustrations. Fig. 115; Menézes 1976:fig. 27.

Diagnosis. The absence of everted teeth that form "tusks" will distinguish this species from Roeboides spp. It has a much more pronounced humpback, and much smaller scales (over 100 in the lateral-line series vs fewer than 85) than the Acestrocephalus or Galeocharax present in the Apure drainage.

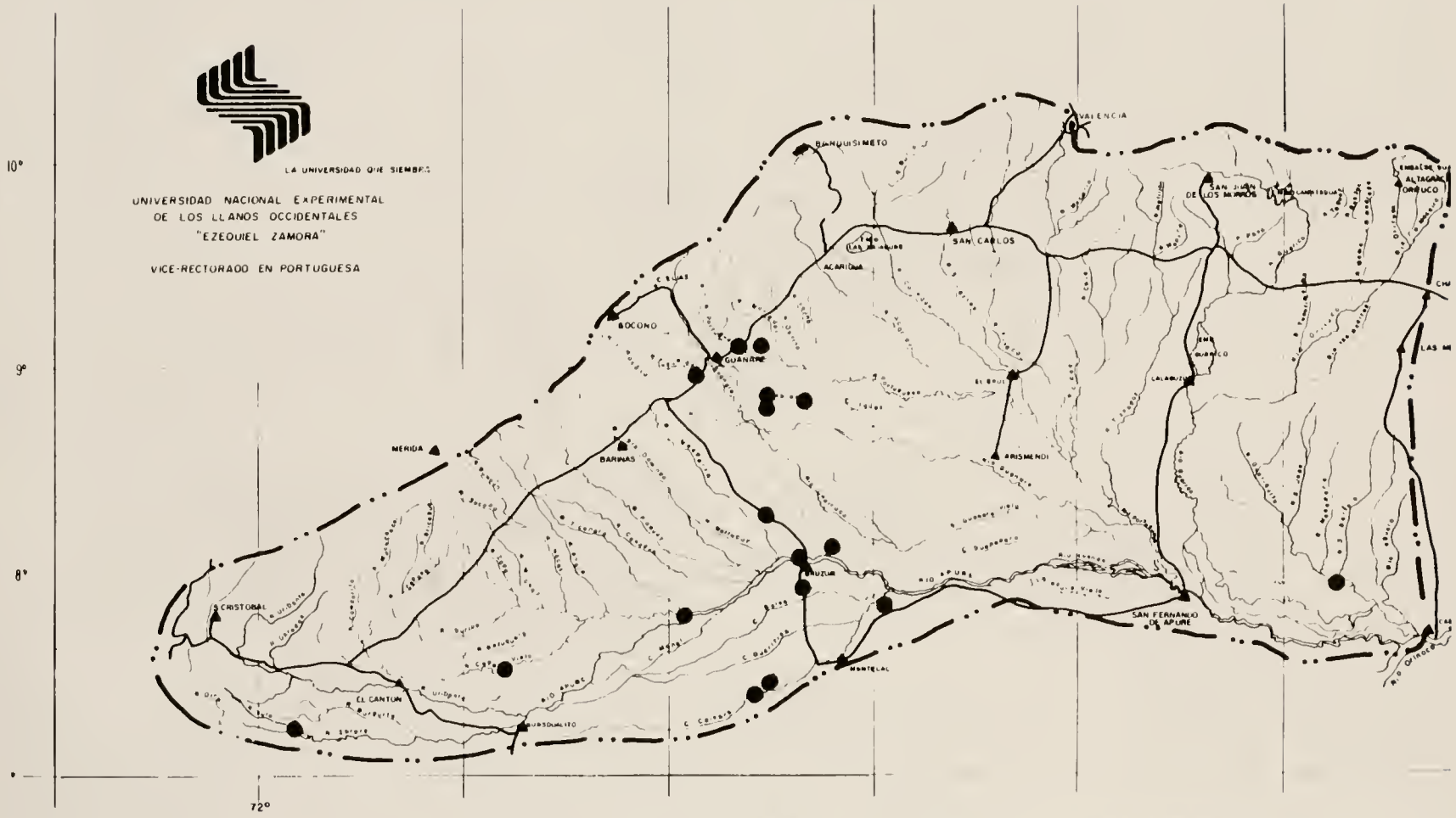
Size. This species reaches at least 120 mm SL.

Morphology. The pectoral-fin base shield is not particularly developed, but the cleithrum is notched to receive the pectoral-fin base. The dorsal-fin origin is in front of anal-fin origin. The scales are ctenoid and the lateral line is complete.

Counts. DR ii9; AR ii47-ii49; PR i14; VR i7; LLS 104-110; TS 26 above LL, 25 below; maxilla with 46 teeth; one row of large teeth on mandible, the second "row" represented by only 2-3 conical teeth near the symphysis. Anal sheath with 5 rows anteriorly, but reduced to 2 posteriorly.

Pigmentation. The humeral spot is rounded to oval, located near the opercle, and is larger than the eye. The caudal spot is small and rounded. The lateral stripe is silvery, narrow at both ends, and wider in the middle. The fins are clear.

Figure 116. Apure drainage distribution of *Cynopotamus bipunctatus*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 116. This is a low piedmont and llanos species with a spotty distribution.

Habitat. It is usually taken from larger whitewater rivers.

Abundance. COMMON.

Number of specimens examined. 220 from 31 collections. These specimens are the first to be reported since the unique holotype was described.

Food. CARNIVORE. This species is mostly piscivorous.

Reproduction. Strategy: probably r2. Spawning is probably annual and synchronous with the onset of the rains.

Migrations. It is probably capable of long local movements to avoid drought.

Engraulisoma cf *taeniatum* Castro 1981

Sardinita Anchoa - Anchovy Tetra

Fig. 117. Map: fig. 118. Couplet 73a.

Generic synonymy

Engraulisoma Castro 1981:135 (type species: *Engraulisoma taeniatum* Castro 1981, by original designation).

Specific synonymy

Engraulisoma taeniatum Castro 1981:137 (type locality: Brazil, Mato Grosso, Poconé, Río Cuiabá).

Comments. Though Apure specimens agree fairly well with the original description, this could be a new species since the monotypic genus was hitherto known only from southern Brazil in the Amazon Basin.

Etymology. ENGRAULI = anchovy, SOMA = body; TAENIATUM = striped.

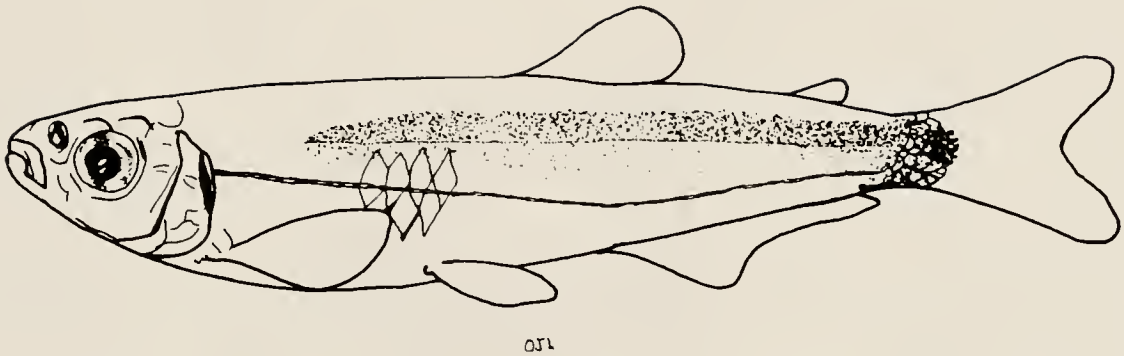


Figure 117. Engraulisoma cf taeniatum.

Description

Illustrations. Fig. 117.

Diagnosis. This is the only fish in the Apure drainage that looks like an anchovy but has the teeth (and adipose fin) of a characid. The lateral line is decurved and passes within 1-4 scales of the anal-fin base. The rounded abdomen distinguishes them from small Triportheus.

Size. It grows to about 50 mm SL.

Morphology. The pectoral fins are placed low on the body. The pelvic fins are entirely anterior to the dorsal fin. The dorsal-fin origin is anterior to the anal-fin origin. The lateral line is complete.

Counts. DR ii8; AR ii22; PR 9; VR i6; LLS 35; TS 8; premaxillary teeth 2-4; no teeth are visible on the maxilla.

Pigmentation. A wide dark lateral stripe extends from behind the opercle (which it does not touch, however) to the base of the caudal fin, but is separate from the spot on the tail. The rest of the body is white in preservative.

Distribution and Natural History

Range. Amazon and Orinoco basins.

Apure distribution. Map: fig. 118. The anchovy tetra is widely distributed from mountains to llanos.

Habitat. This species is found in sections of larger rivers and streams with fast currents.

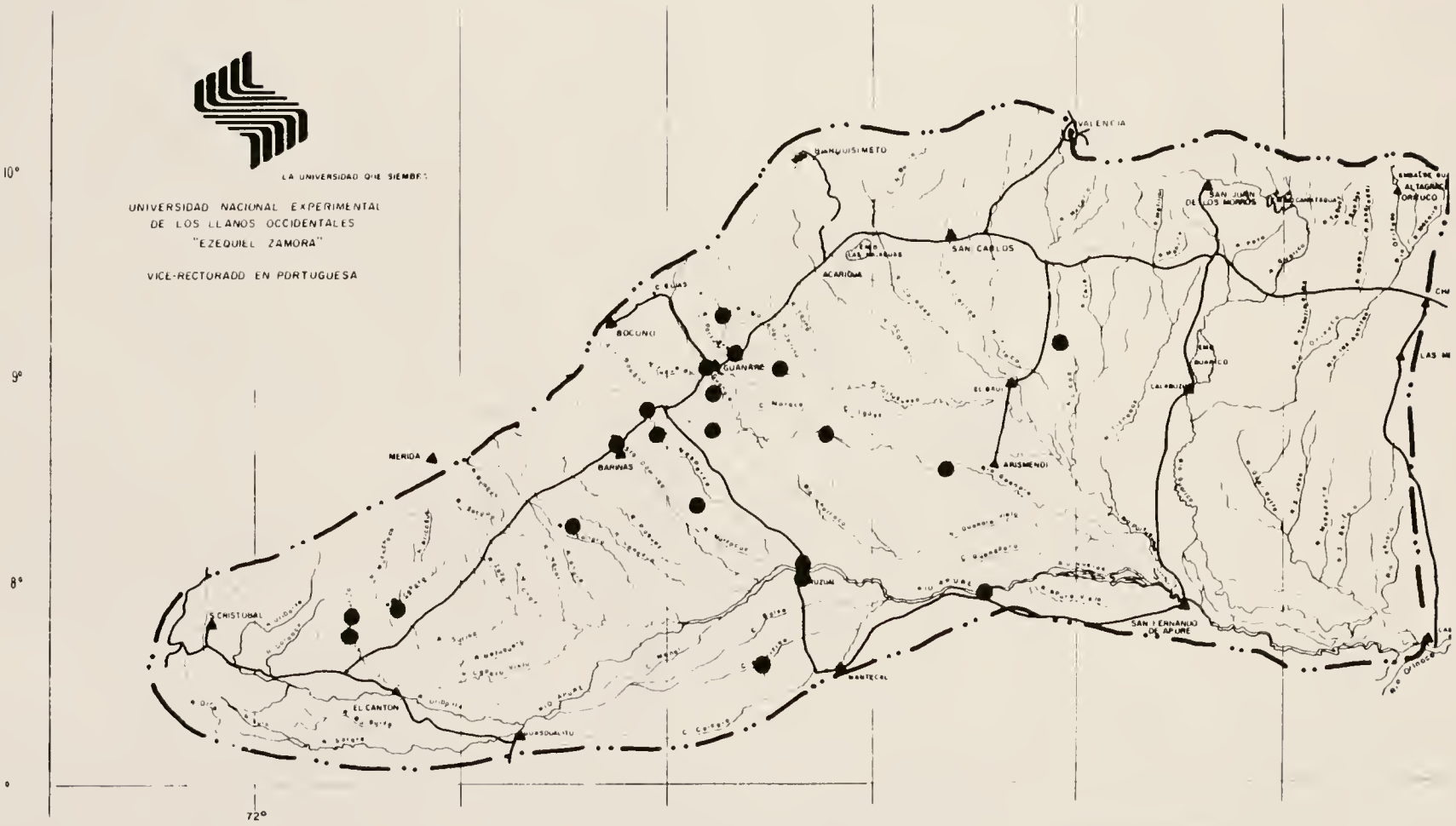
Abundance. COMMON.

Number of specimens examined. 129 from 31 collections.

Food. It probably feeds on items of the drift carried down by the current.

Reproduction. Strategy: probably rl.

Figure 118. Apure drainage distribution of *Engraulisoma* cf *taeniatum*.



CUENCA DEL RIO APURE

Galeocharax sp.

Dientón Alargado

Fig. 119. Map: fig. 120. Couplet 42b.

Generic synonymy

Galeocharax Fowler 1910:790 (type species: Cynopotamus gulo Cope 1870:565, by original designation); Menézes 1976:40 (diagnosis).

Comments. Menézes (1976) diagnosed the three genera of the subfamily Cynopotaminae by means of a key. He recognized three species: G. humeralis from the Paraguay and Lower Paraná basins, G. gulo from the Amazon and Sâo Francisco basins, and G. kneri from the upper Paraná. Of these G. humeralis can be eliminated as representing the Apure specimens since it has 98-101 lateral-line scales. The range of 79-84 LLS seen in Apure specimens agrees with both the remaining species, G. gulo and G. kneri which are separable only on the basis of morphometrics and number of teeth on the dentary. Thus, a careful comparison with Amazonian material is necessary to place the Apure specimens, which represent a new record for the Orinoco Basin for the genus and probably represent a new species as well.

Etymology. GALEO = helmet, from the Greek, CHARAX = palisade, from the Greek (Eigenmann 1927), in this case a palisade of teeth, but also given to mean a "gnasher of teeth" in Eigenmann's earlier works, Charax is a genus of characid frequently used in the formation of generic names.

Description

Illustrations. Fig. 119.

Diagnosis. Galeocharax is characterized by the following combination of characters: the lower edge of the cleithrum is sinuous, not

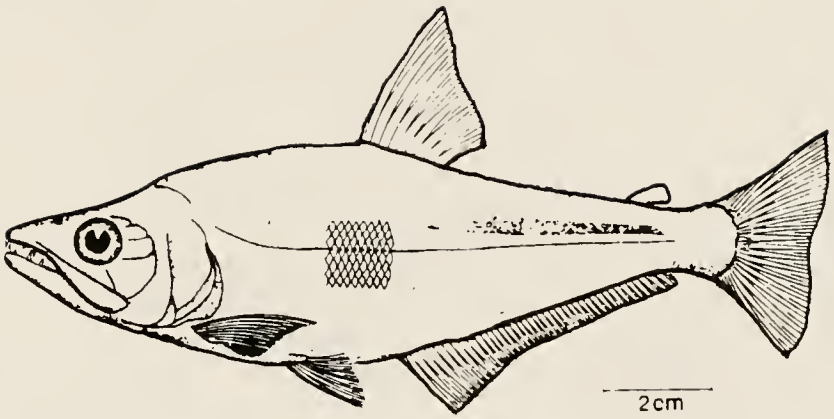


Figure 119. Galeocharax sp. After Menézes (1976).

notched; the anterior dorsal region is only slightly elevated; the dentary has an inner row of 7-11 small conical teeth; the nasal bone is laminar; the ectopterygoid is without a ventral bony crest; the anal fin has about 47 rays; and the lateral line has 80-101 pored scales (Menézes 1976). This species is easily confused with Acestrocephalus cf boehlkei, but can be distinguished by the absence of black spots on the tip of the chin and the anal and dorsal-fin origins (present in young Acestrocephalus), and in having the first pair of canines widely separated (by a distance at least as great as their length).

Size. It grows to at least 90 mm SL.

Morphology. The scales are ctenoid. The lateral line is complete.

Counts. DR 11; AR 47; LLS 79-84.

Pigmentation. It is mostly plain silvery with transparent fins.

Distribution and Natural History

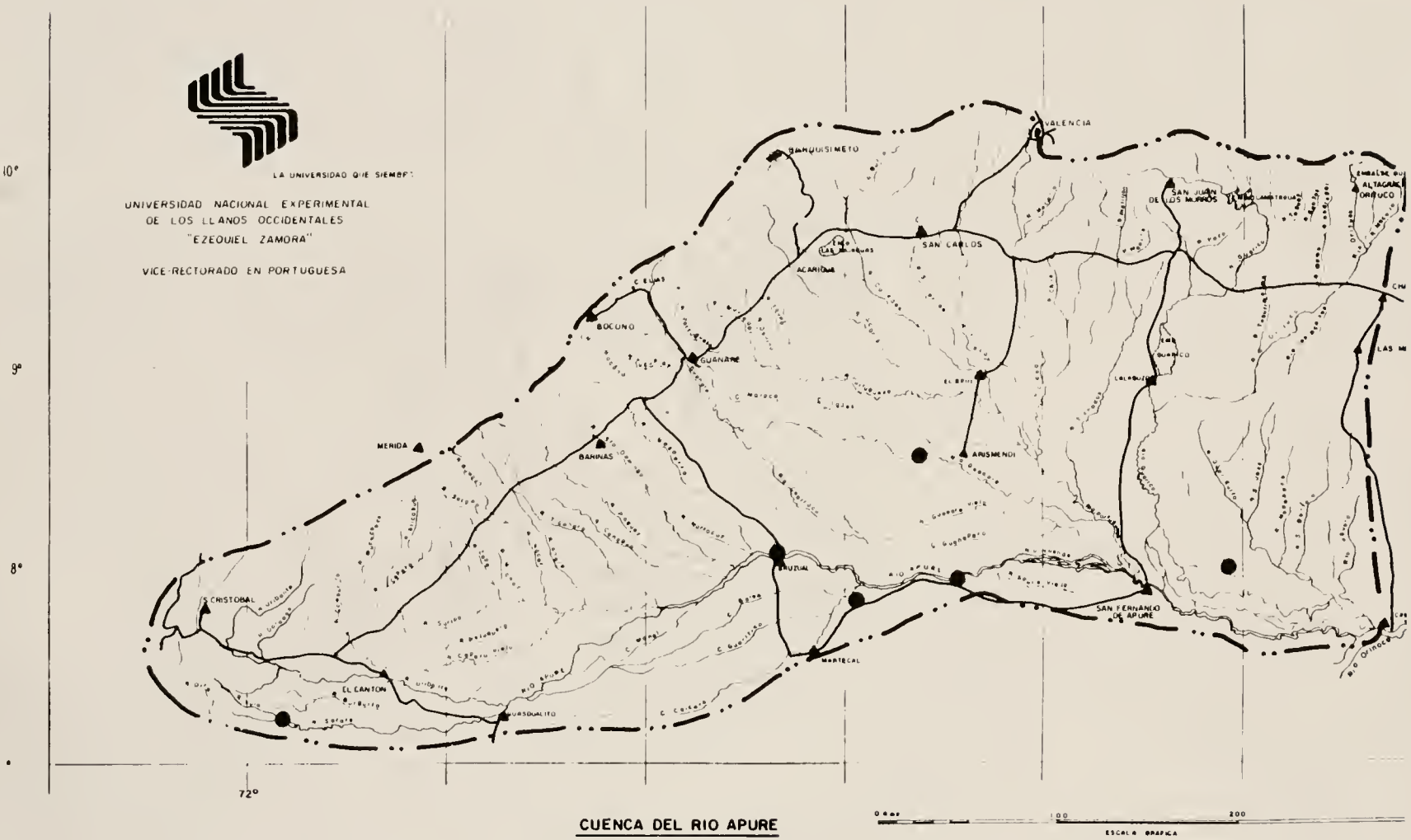
Range. Until now, the genus Galeocharax has been known only from the Amazon, Paraná and Sâo Francisco basins.

Apure distribution. Map: fig. 120. This species is known only from large rivers in the low llanos.

Habitat. Galeocharax sp. inhabits large whitewater rivers. Menézes (1976) hypothesized that Galeocharax may compete with Acestrocephalus in the Amazon basin, and thus restrict the latter to the upper reaches of the drainages where they occur together. This does not seem to be the case in the Apure drainage, but perhaps a similar pattern will emerge once their distribution throughout the Orinoco Basin is better known.

Abundance. UNCOMMON.

Figure 120. Apure drainage distribution of Galeocharax sp.


LA UNIVERSIDAD QUE SIEMBRA
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
GUANARE
MERIDA
BARINAS
ARISMENDI
MUTUAL
MARTECAL
SAN FERNANDO DE APURE
S. CRISTOBAL
EL CANTON
GUASDUALITO
RIO APURE
SAN JUAN DE LOS MORROS
ALTAGRACIA ORITUCO
LAS MERCEDES
EL BRIT
LOS BOCHINCHES
EMBALSE DE ALTAGRACIA ORITUCO
CUENCA DEL RIO APURE
0 4 8 12
100
200
ESCALA GRAFICA

Number of specimens examined. 306 from 22 collections.

Food. CARNIVORE. Piscivore.

Reproduction. Strategy: probably r2. Spawning is probably annual and synchronous with the onset of the rains.

Gephyrocharax valenciae Eigenmann 1920

Sardinita - Tetra

Figs. 31 (spur in male) & 121. Map: fig 122. Couplet 11a.

Generic synonymy

Gephyrocharax Eigenmann 1912:23 (type species: Gephyrocharax chocoensis Eigenmann 1912, by original designation).

Specific synonymy

Gephyrocharax valenciae Eigenmann 1920:11 (type locality: Isla del Burro, Lake Valencia, Venez.), seen; Pearse 1920:21 (Río Bue, L. Valencia, Venez.); Eigenmann & Myers 1929:484 (L. Valencia area, Venez.); Schultz 1944b:323 (key, Barquisimeto, L. Valencia, upper Río Guárico, and Caripito, Venez.); Mago L. 1970:70; Géry 1977:353, 358 (key).

Types. Holotype: CAS 44297 (formerly IU 15131); Paratypes: CAS 44294(99) (IU 15129); CAS 44295(2) (IU 15130); CAS 44296(3) (IU 15131).

Etymology. GEPHYRO = bridge, from the Greek, CHARAX = palisade, from the Greek (Eigenmann 1927), in this case a palisade of teeth, but also given to mean a "gnasher of teeth" in Eigenmann's earlier works, Charax is a genus of characid frequently used in the formation of generic names and Eigenmann interpreted Gephyrocharax as a bridge between the genera Paragoniates and Hysteronotus; VALENCIAE = after Lake Valencia, type locality of this species.

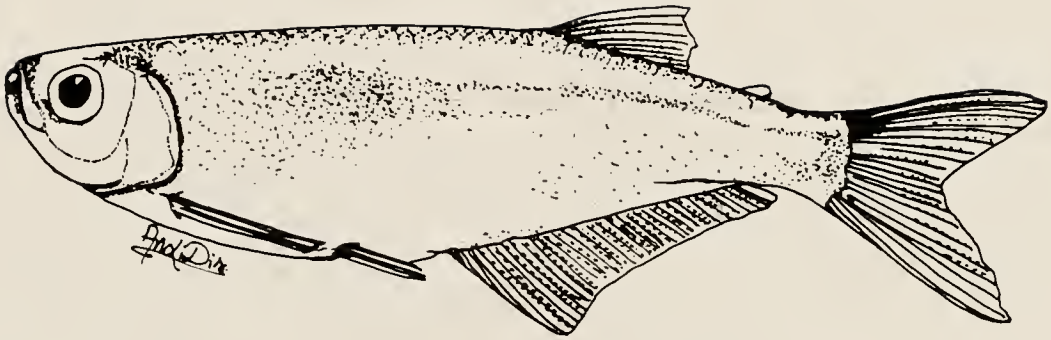


Figure 121. Gephyrocharax valenciae.

Description

Illustrations. Figs. 41 (caudal spur of males) & 121; ?Géry 1977:352 (as unidentified species of Gephyrocharax), 353; Román 1985:158.

Diagnosis. The development of a caudal spur in males (fig. 41) is known only in this species and Corynopoma riisei. The latter lacks an adipose fin (present in G. valenciae). This species is further distinguished by the straight dorsal profile, and the posterior position of the dorsal-fin origin (well behind the anal-fin origin).

Size. This fish grows to about 50 mm SL, but most individuals are between 30-40 mm.

Morphology. The dorsal-fin origin is midway between a point an eye diameter behind edge of the opercle and the caudal-fin base. The eye is longer than the snout, and measures three times in the head length, but is slightly less than the interorbital width. The frontal fontanel extends to the ethmoid (middle of the interorbital space).

Counts. DR ii7-ii8; AR 30-32; PR i9-i10; VR i6; LLS 40-42; TS 5-6 1/2 above LL, 5-7 below.

Measurements. Head 4.33, Depth 3.33-3.66.

Pigmentation. The body is silvery, without a humeral spot. There is a silvery lateral stripe underlain with black pigment that continues as a diffuse caudal blotch, but which does not extend onto the tips of the central caudal-fin rays. The jaws are black-tipped.

Distribution and Natural History

Range. Orinoco Basin.

Apure distribution. Map: fig. 122. It is common throughout the drainage.

Figure 122. Apure drainage distribution of *Gephyrocharax valenciae*.

CUENCA DEL RIO APURE

Habitat. It occurs in almost any body of running water, but is more common in the piedmont.

Abundance. ABUNDANT.

Number of specimens examined. 5,636 from 211 collections.

Food. CARNIVORE. This fish usually feeds on terrestrial insects, aquatic insects and microcrustaceans (K. Winemiller, pers. com.). Pearse (1920) reported a similar but more varied diet that included algae, plants, chironomids, beetles, ants, cladocerans, cyclops, ostracods, mites, and sediment from Lake Valencia.

Reproduction. Strategy: r1; generation time: 4 months; fecundity: 734 eggs/female; egg diameter: 0.75 mm (Winemiller & Taphorn 1989). This species spawns during the most of the rainy season. Individuals may spawn more than once per season.

Importance. Ornamental.

Gnathocharax steindachneri Fowler 1913

Dientoncito

Fig. 123. Map: fig. 124. Couplet 6a.

Generic synonymy

Gnathocharax Fowler 1913b:560 (type species: Gnathocharax steindachneri Fowler, by original designation).

Specific synonymy

Gnathocharax steindachneri Fowler 1913:561, fig. 19 (type locality: "Igarapé do Candelaria, Río Madeira; Río Madeira 100 east of the meridian 60 20'; trib. of Río Madeira near Porto Velho, Brazil") seen; Myers 1934:5 (near Caicara, Venez.); Böhlke 1955b:1; Mago L. 1970:70; Géry 1977:304, 305, 311 (key).

Comments. Careful analysis of the Apure specimens might reveal subspecific differences between them and the Amazonian form.

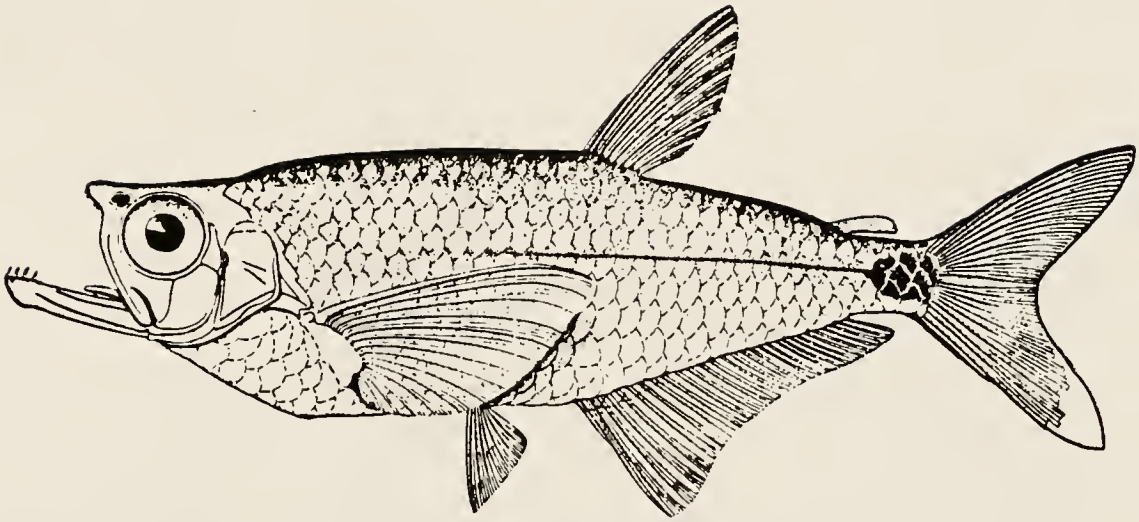


Figure 123. Gnathocharax steindachneri.

Etymology. GNATHO = jaws, CHARAX = palisade, from the Greek (Eigenmann 1927), in this case a palisade of teeth, but also given to mean a "gnasher of teeth" in Eigenmann's earlier works, Charax is a genus of characid frequently used in the formation of generic names; STEINDACHNERI after Dr. F. Steindachner, Austrian ichthyologist, and pioneer in South American taxonomic research.

Description

Illustrations. Fig. 123; Böhlke 1955b:14; Géry 1977:304, 305; Román 1985:180.

Diagnosis. This fish is distinguished by the following combination of characters: an incomplete lateral line; the dorsal-fin origin behind the anal-fin origin; a large mouth with canine teeth; a maxillary bone that is longer than the vertical diameter of the eye; and an anal fin with 40 rays or fewer.

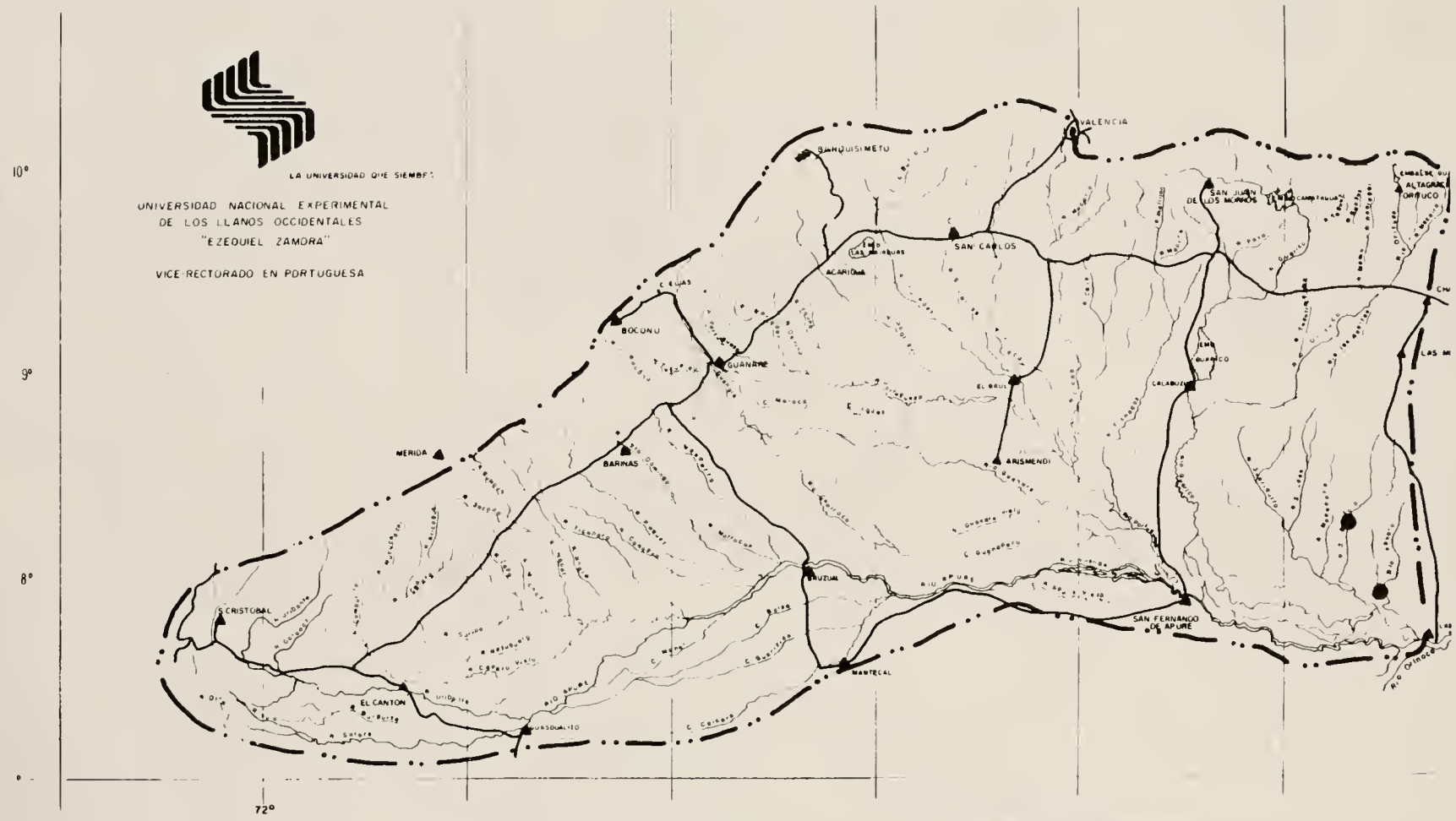
Size. It grows to about 80 mm SL, but most individuals are smaller.

Morphology. The body is greatly compressed, wedge-shaped in cross section with the point ventral. The ventral edge of the belly is keeled between the pectoral and ventral-fin bases. There are only 5-6 pored scales in the lateral line. The ventral profile of the head is swept upward greatly toward the front, giving rise to an extremely oblique gape. Thus, the lower jaw juts forward beyond the upper. There are canine teeth present in both jaws. The pectoral fins are long and falcate and the caudal fin is deeply forked.

Counts. DR ii7; PR i14-i17; AR iii26-iii32; VR i7; LLS 35; GR 9-10.

Measurements. GBD 3.0-3.4 in SL; HL 3.5-3.8 in SL.

Figure 124. Apure drainage distribution of *Gnathocharax steindachneri*.



CUENCA DEL RIO APURE

Pigmentation. The body is silvery-gray to tan, and the iris of the eye, opercle and circumorbital bones are also silvery. There is a large caudal blotch. A thin black line is present on the sides above the anal-fin base, and along the anal-fin base. The dorsum has a dark mid-dorsal line.

Distribution and Natural History

Range. It occurs in the Río Madeira and Río Negro in Brazil; the upper Orinoco in Venezuela, and Guyana.

Apure distribution. Map: fig. 124. This species has been found only in the Aguaro River system in the southeastern corner of the Apure drainage.

Habitat. It occurs in blackwater streams with aquatic vegetation.

Abundance. RARE.

Number of specimens examined. 2 from 2 collections.

Food. CARNIVORE. It probably feeds on small fishes and insects that fall to the water's surface. It seems to be designed for surface dwelling, as Böhlke (1955b) pointed out.

Reproduction. Probable strategy: r1.

Importance. Ornamental.

Gymnocorymbus thayeri Eigenmann 1908

Sardinita Negra - Black Tetra

Fig. 125. Map: fig. 126. Couplet 85b.

Generic synonymy

Gymnocorymbus Eigenmann 1908:93 (type species: Gymnocorymbus thayeri, by original designation).

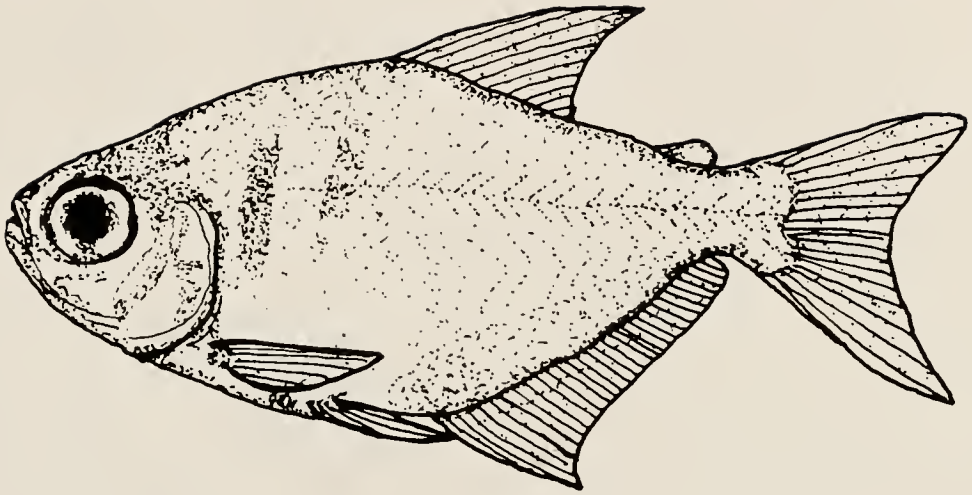


Figure 125. Gymnocorymbus thayeri.

Specific synonymy

Gymnocorymbus thayeri Eigenmann 1908:93 (type locality: Río Amazonas from Tabatinga to Gurupa), seen; Fowler 1940:99; 1945:103 (Colombia); Géry 1977:367, 451, 453-56.

Types. Holotype: MCZ 19242 (indicated as such by Eigenmann 1918:125). Paratypes: MCZ 19272, 20706, 20710, 20720, 20724, 20789, 20804, 20807, 20984, 20973, 20998, 21001, 21007, 21065,

Comments. It is difficult to distinguish between G. thayeri Eigenmann 1908 and G. socolofi Géry 1972 using Géry's (1977) criteria. The Apure drainage population may be the latter species.

Etymology. GYMNO = naked, from Greek, and means in this case unscaled, CORYMBUS = summit or nape in this case, also from Greek, alluding to the unscaled predorsal line in this genus; THAYERI named in memory of Mr. S. V. R. Thayer, a volunteer of the Nathaniel Thayer Expedition to Brazil.

Description

Illustrations. Fig. 125; Géry 1977:453, 456; Axelrod et al. 1971:F-302.00.

Diagnosis. The deep, highly compressed body and the double, vertically elongated humeral bars are the first clues to the identity of this species. Although it is superficially quite similar and is easily confused with Ctenobrycon spilurus, Gymnocorymbus thayeri lacks the ctenoid scales found in the former. It is distinguished from the look-alike Poptella orbicularis in lacking the embedded predorsal spine characteristic of that species, and by the absence of black pigment on the first anal-fin rays.

Size. It grows to about 50 mm TL.

Morphology. The snout is short and the mouth oblique. The lateral line is complete. The anal fin is relatively long with a nearly straight margin. The anal and caudal fin are scaled at their bases. The first and second suborbital are narrow and do not cover the entire cheek (ie. they don't extend postero-ventrally to the preopercular bone).

Counts. DR 11; AR 34-41, usually 37-38; LLS 32.

Measurements. HL 3.5 in SL; GBD 1.4-2.1, mean 1.7 in SL.

Pigmentation. The body is silvery, the humeral spot double, and vertically elongate. All fins are reddish in young fish.

Distribution and Natural History

Range. It occurs in both the Amazon and Orinoco basins.

Apure distribution. Map: fig. 126. This fish is most commonly taken from blackwater streams in northern Apure state, from the Aguaro River system in the southeasternmost part of the drainage, and in Barinas in the Suripá system.

Habitat. Lowland llaneran streams, usually with clear or blackwater, located in the sandy grassland areas of the drainage are the typical habitat of this species.

Abundance. COMMON.

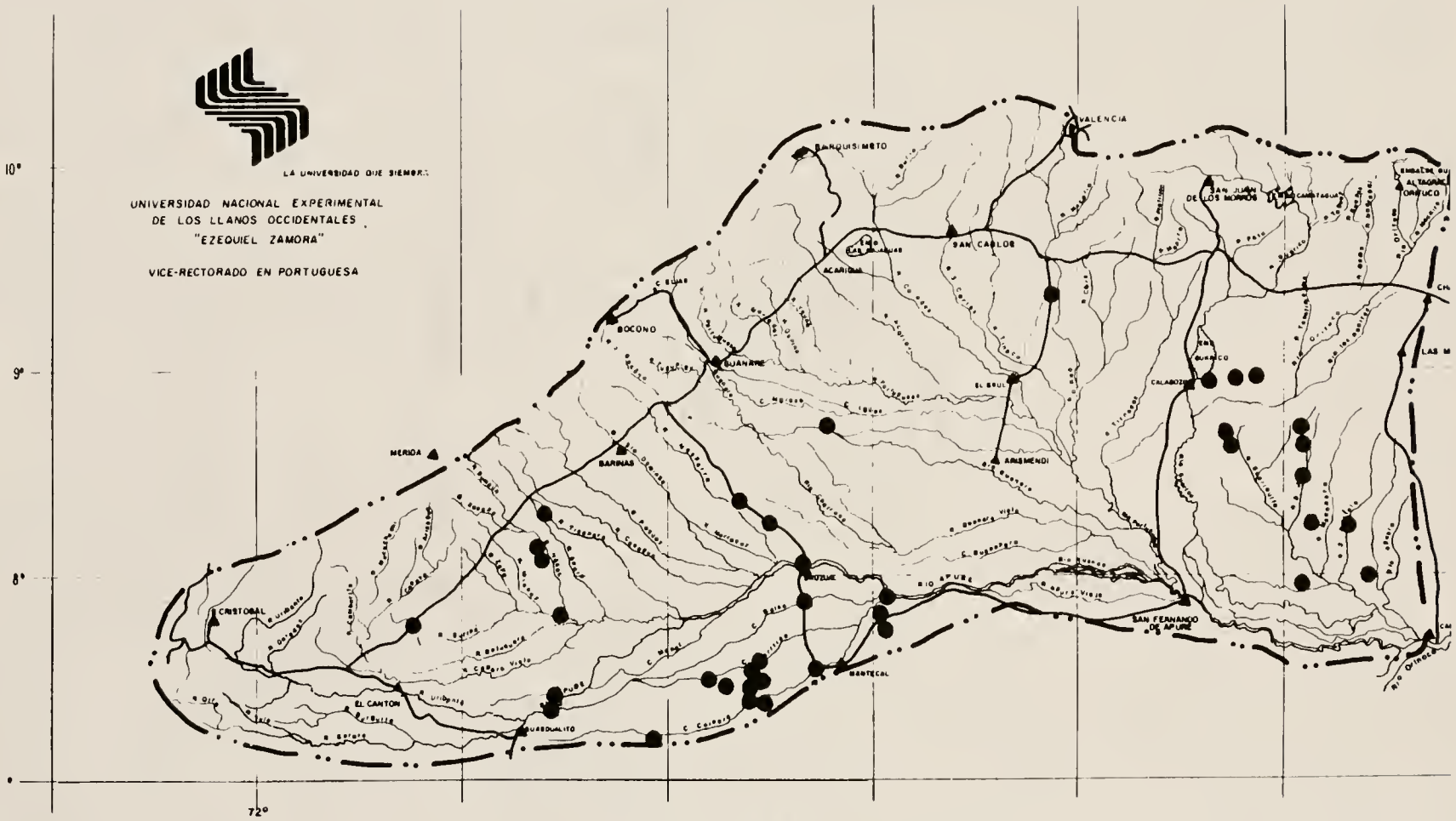
Number of specimens examined. 11,035 from 157 collections.

Food. OMNIVORE. It eats a wide variety of small foods, seeds, insects etc.

Reproduction. Strategy: probably r1. Eggs are scattered among vegetation and then abandoned. In captivity, live foods are usually required to bring them into peak condition for spawning. Males have tiny hooks on the anal fin, that are probably used during fertilization.

Importance. Ornamental.

Figure 126. Apure drainage distribution of *Gymnocorymbus thayeri*.



CUENCA DEL RIO APURE

Hemibrycon metae Myers 1930

Sardina de Montaña - Mountain Tetra

Fig. 127. Map: fig. 128. Couplet 91a.

Generic synonymy

Hemibrycon Günther 1864:318 (type species: Tetragonopterus polyodon Günther, by monotypy).

Specific synonymy

Hemibrycon metae Myers 1930:68 (type locality: Colombia, Guaicaramo, at the junction of the Río Guavio and the Río Upia, almost due east of Bogotá and north of Barrigón. The elevation is between 300 and 400 meters and there is direct communication with the Meta through the Upia), seen; Géry 1962:65.

Hemibrycon taeniurus (not Gill) Eigenmann 1920:11 (El Consejo, Río Tuy and Río Tiquirito, Venez.).

Hemibrycon dentatus Eigenmann 1927:412 (Villavicencio, Colombia).

Hemibrycon dentatus metae Schultz 1944b:363 (key); Mago L. 1970:71.

Types. Holotype: CAS-SU 23727, examined. I also examined the holotype, FMNH 56253, of the related H. dentatus.

Comments. Myers (1950) gave the following diagnosis: "Allied to H. dentatus (Eigenmann) and H. decurrens (Eigenmann) in the sagging lateral line, differing in the smaller eye, shorter head, and projecting lower jaw, and variously from one or the other in anal-fin position, depth of peduncle, and number of scales." He further suggested that given sufficient material those three species might prove to be only subspecifically different.

Schultz (1944b) considered all his specimens as subspecies of H. dentatus, but Géry (1962, 1977) pointed out that H. dentatus is

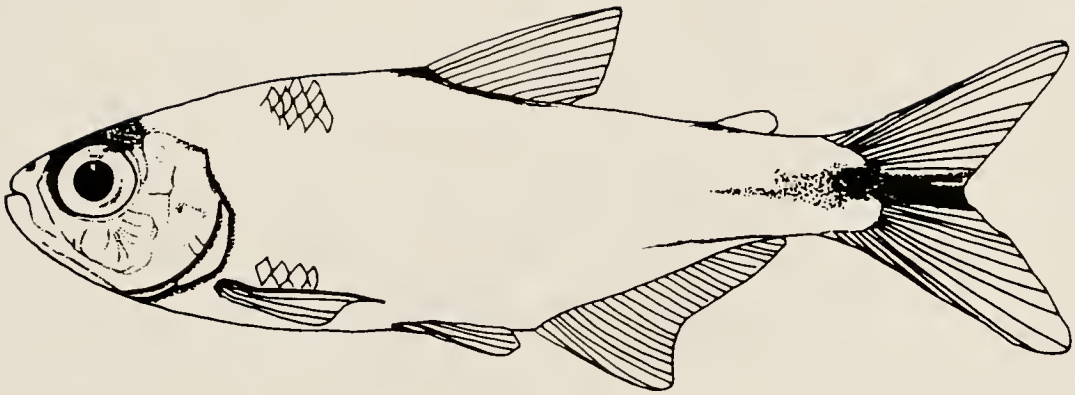


Figure 127. Hemibrycon metae.

restricted to the Cauca River and that Schultz's paratypes included small specimens of Bryconamericus, accounting for some of the variability Schultz noted in the original description of his H. dentatus jabonero from the Maracaibo Basin.

I have adopted the system supported by Géry (1962, 1967), recognizing most populations as distinct species.

Etymology. HEMI = half, BRYCON = Brycon, a genus of characid; METAE = for the Río Meta drainage, where the species was first collected.

Description

Illustrations. Fig. 127.

Diagnosis. The jet black stripe through the central caudal-fin rays is characteristic of this species. It is easily confused with Astyanax species, but is differentiated by the presence of several (up to 20) teeth on the maxilla (the number increases with size). Small specimens are similar to Bryconamericus species but have more lateral-line scales (42 or more).

Size. It grows to 100-120 mm SL.

Morphology. The lateral line is complete, a bit decurved anteriorly and then running low along the sides. The caudal fin is naked except for a very large scale at the base of each lobe. The dorsal-fin origin is slightly closer to the tip of the snout than to the of the caudal fin. The anal fin has a single scale row at its base.

Counts. DR ii8-ii9; AR iii26-30; PR i11-i13; VR i6-i8; LLS 42-44; TS 17 8-9 above LL, 6-8 below LL; PDS 13; premaxilla with two rows of teeth, 3-5 in the outer, four in the inner; maxillary teeth four in smaller specimens, up to 20 in largest, dentary teeth eight (four large, four smaller); GR 11.

Figure 128. Apure drainage distribution of *Hemibrycon metae*.

CUENCA DEL RIO APURE

Measurements. GBD 3.0-3.5 in SL. HL 4.66 in SL.

Pigmentation. The dark black lateral stripe is continuous, and runs from a vague humeral spot posteriorly to the tips of the central caudal rays. The dorsal adipose and anal fins are speckled with melanophores, and most of the body is also somewhat flecked with pigment. The tips of the anal-fin rays are often milk white.

Distribution and Natural History

Range. It occurs in Orinoco Basin.

Apure distribution. Map: fig. 128. This species is most common in the Andes mountains and piedmont.

Habitat. Andean streams, with fast currents, clear clean water, and gravel to rock substrate are the typical habitat of this species.

Abundance. COMMON.

Number of specimens examined. 1,190 from 87 collections.

Food. OMNIVORE. This species feeds on insects, seeds, and other items brought downstream by the current.

Reproduction. Strategy: probably r2. Probably annual and synchronous with the onset of the rains.

Hemigrammus cf *analis* Durbin 1909

Sardinita - Tetra

Fig. 129. Map: fig. 130. Couplets 34b & 66a.

Generic synonymy

Hemigrammus Gill 1858:420 (type species: *Poecilurichthys* (*Hemigrammus*) *unilineatus* Gill, by monotypy).

Holopristis Eigenmann 1903:145 (type species *Tetragonopterus ocellifer* Steindachner 1882:179, by original designation).

Holopristes Eigenmann & Ogle 1907:11 (type species: *Tetragonopterus ocellifer* Steindachner 1882:179, by original designation).

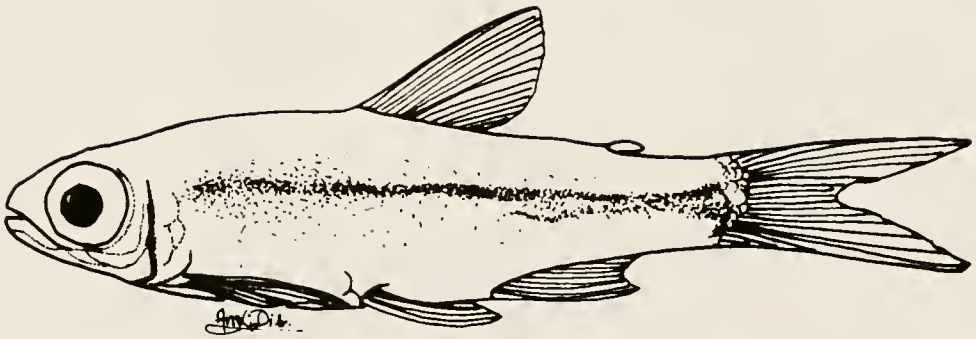


Figure 129. Hemigrammus cf analis.

Specific synonymy

Hemigrammus analis Durbin 1909:64 (type locality: Rockstone, British Guiana), seen; Eigenmann 1918:171 (key, synonymy); Géry 1977:371,494 (key).

Types. Holotype: FMNH 53041 (CM1466), examined; Paratypes: FMNH 45 specimens from three localities; CAS-SU 21913(2), 21914(1), 44360(9), 44361(5), 44362(1).

Comments. This identification is tentative.

Etymology. HEMI = half, GRAMMUS = line, referring to the incomplete lateral line; ANALIS = probably refers to the relatively short anal fin.

Description

Illustrations. Fig. 129; Eigenmann 1918:pl. 22.

Diagnosis. This species has fewer anal-fin rays (12-15 vs 19 or more in the other species) than any other Hemigrammus species in the Apure drainage.

Size. It can grow to about 40 mm SL.

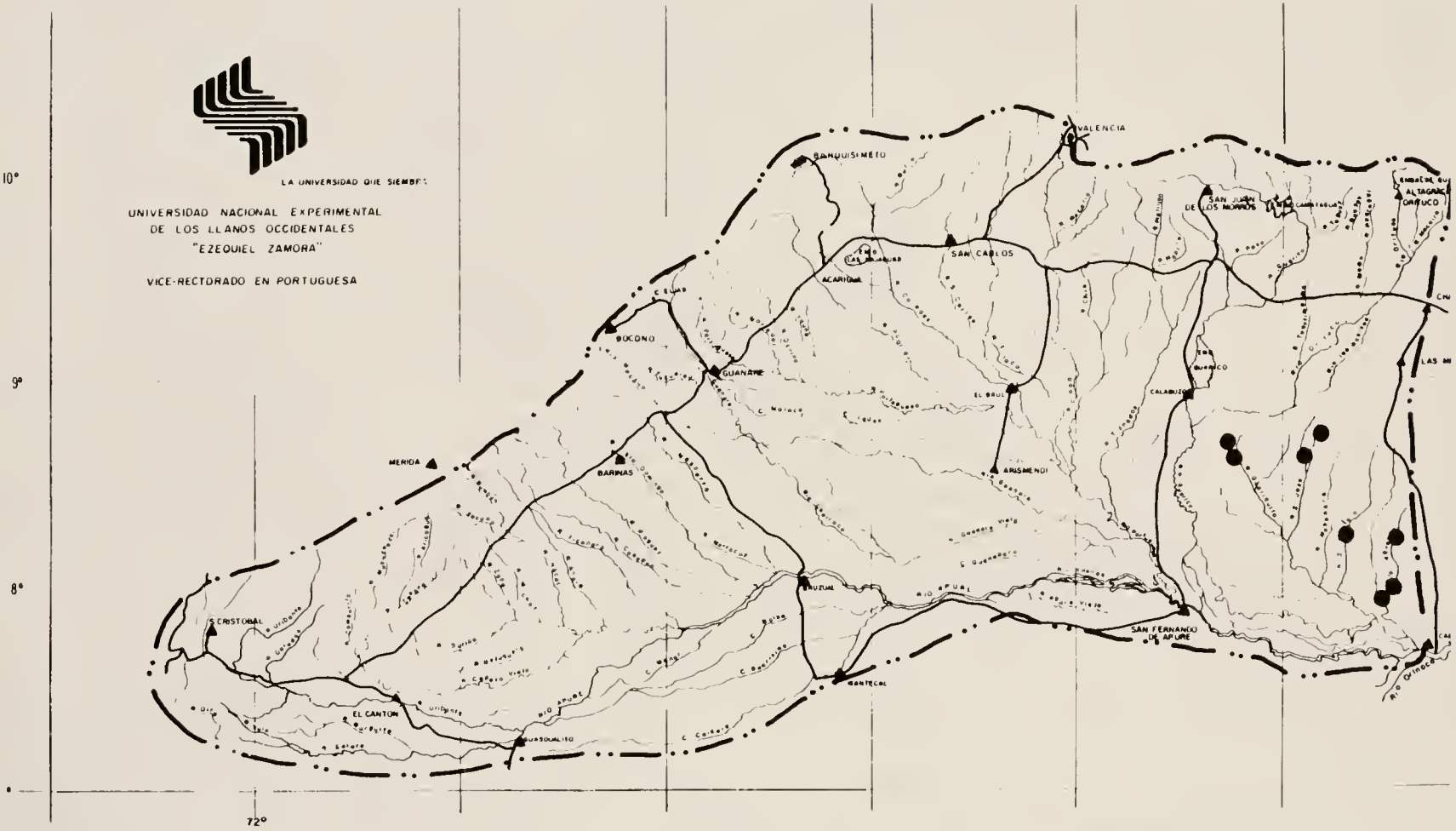
Morphology. As in all Hemigrammus the lateral line is incomplete, and the base of the caudal fin is scaled. There are about eight pored scales. They do not extend beyond the tips of the depressed pectoral fin.

Counts. DR 11; AR 12-15; LS 30-32; TS 5 above, 3 below LL; premaxilla with 5 seven-cusped teeth in the inner row, 4 in the outer row (on each side); maxilla with one multicuspid tooth; GR 9.

Measurements. HL 3.5-3.8 in SL; GBD 3.2-3.5.

Pigmentation. The humeral spot is weak and rounded. The lateral stripe does not extend onto the tail. There is a dark line or dot along the ventral midline of the caudal peduncle.

Figure 130. Apure drainage distribution of *Hemigrammus analis*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in Guyana, and in the Orinoco basin.

Apure distribution. Map: fig. 130. This species has been found only in the Aguaro River system drainage, in the southeastern corner of the Apure drainage.

Habitat. Blackwater streams of low llanos in sandy savanna are the preferred habitat of this species.

Abundance. UNCOMMON.

Number of specimens examined. 147 from 11 collections.

Food. OMNIVORE. Seeds, microcrustaceans, and insects are the main items of this species' diet.

Reproduction. Strategy: probably r1; most *Hemigrammus* have a fecundity of 100-200 eggs/female with an egg diameter of about 0.75 mm. It reaches sexual maturity quickly, in about 4 months, and probably spawn repeatedly throughout most of the wet season (Winemiller & Taphorn 1989).

Importance. Ornamental.

Hemigrammus barrigonae Eigenmann & Henn 1914

Sardinita Dos Líneas - Two-Lined Tetra

Fig. 47 (pigmentation) & 131. Map: fig. 132. Couplets 65a & 70a.

Specific synonymy

Hemigrammus barrigonae Eigenmann & Henn 1914:232 (type locality: Barrigona, Colombia (upper Río Meta drainage), seen; Eigenmann 1918:161 (key, description); Géry 1977:490, 502, 503, 528.

Types. Holotype: CAS 44368 (originally IU 13423). Paratypes: CAS 44369(62) (IU 13424).

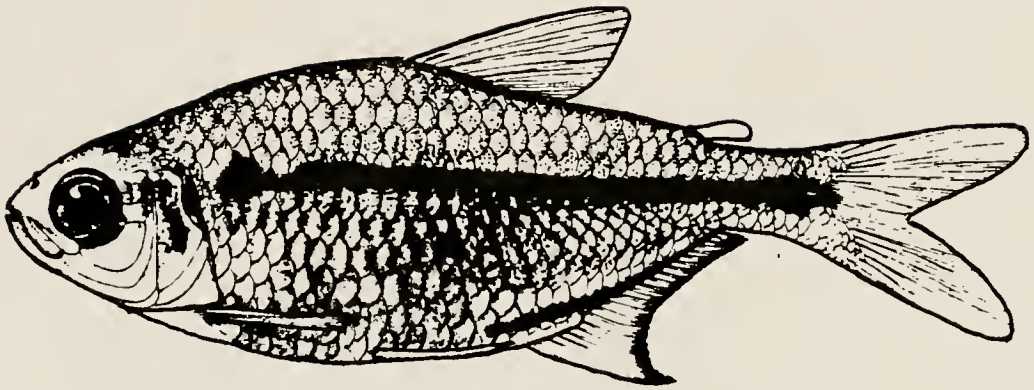


Figure 131. Hemigrammus barrigonae. From Eigenmann (1918).

Comments. The variably pored lateral line observed in this species, which was noted by Eigenmann (1918), has been confirmed in Apure specimens. See comments under *Moenkhausia copei*.

Etymology. BARRIGONAE = after Barrigona, Colombia where the type series was collected.

Description

Illustrations. Fig. 47 (pigmentation) & 131; Eigenmann 1918:pl. 93; Géry 1977:528.

Diagnosis. The deep body and distinctive pigmentation pattern (figs. 47 & 131) are the best guides to the identification of this species. The lateral line is usually incomplete, but sometimes can extend well back behind the dorsal-fin origin. Specimens with a nearly complete lateral line can be confused with *Moenkhausia copei*, but are usually deeper bodied.

Size. It can reach about 40 mm SL.

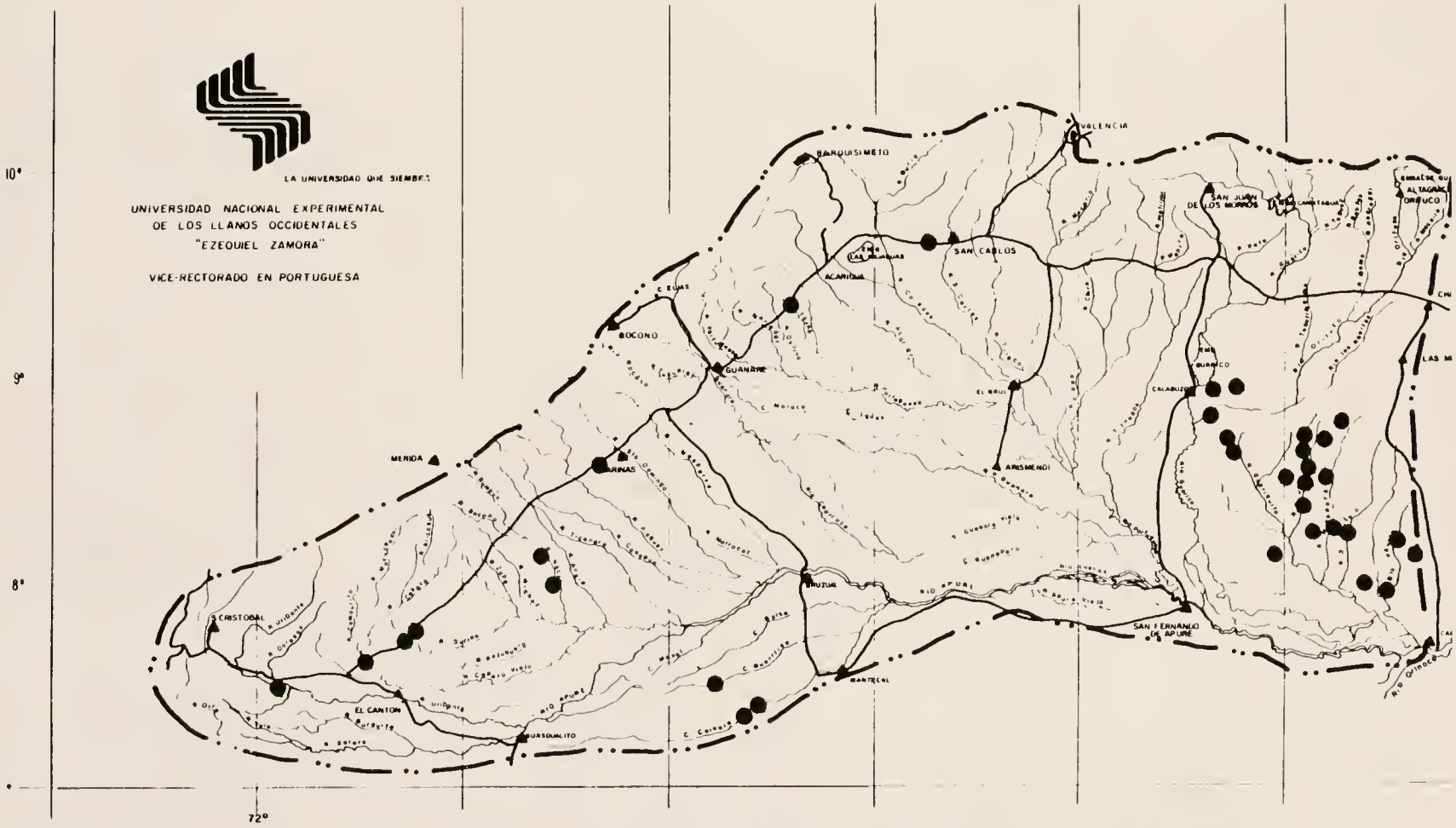
Morphology. The origin of the dorsal-fin is equidistant from snout and base of middle caudal rays. The origin of the anal fin is under that of the dorsal fin. The third suborbital is in contact with the preopercle behind, leaving no naked area on the cheek.

Counts. DR 11; AR 22-25; LS 33-35; TS 11; maxilla with 4 or 5, 6-pointed teeth.

Measurements. HL 4 in SL; BD 2.6 to 2.8 in SL.

Pigmentation. The base color is light tan to olive. The base of the anal fin is marked by a black line. A lateral stripe is present from the operculum to the caudal-fin base, but is not usually continued onto the tail. Humeral and caudal spots are present but overlaid by lateral stripe. The outer margin of the anal fin is usually pigmented.

Figure 132. Apure drainage distribution of *Hemigrammus barrigonae*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It is found in the Orinoco Basin.

Apure distribution. Map: fig. 132. This species occurs in northern Apure state, in the Aguaro River system of the southeasternmost part of the drainage, and in Suripá system of Barinas state.

Habitat. H. barrigonae lives in the quieter areas of blackwater streams with abundant aquatic vegetation, usually in areas with sandy soils.

Abundance. COMMON.

Number of specimens examined. 1,373 from 57 sites.

Food. OMNIVORE. It eats seeds, microcrustaceans, and insects.

Reproduction. Strategy: probably r1. See account of H. analis.

Importance. Ornamental.

Hemigrammus cf elegans (Steindachner) 1882

Sardinita Elegante - Elegant Hemigrammus

Fig. 133. Map: fig. 134. Couplet 57b.

Specific synonymy

Tetragonopterus elegans Steindachner 1882:179 (type locality: Obidos (Middle Amazon) Brazil), not seen; Eigenmann & Eigenmann 1891:53.

Hemigrammus elegans Eigenmann 1910:436; 1918:143 (key, description) Géry 1977:510 (key).

Comments. This identification is tentative.

Etymology. ELEGANS = elegant, pretty.

Description

Illustrations. Fig. 133. Eigenmann 1918:pl. 17, fig. 3.

Diagnosis. This is the only Hemigrammus in the Apure drainage with a black mark in the dorsal fin. However, It might be confused with

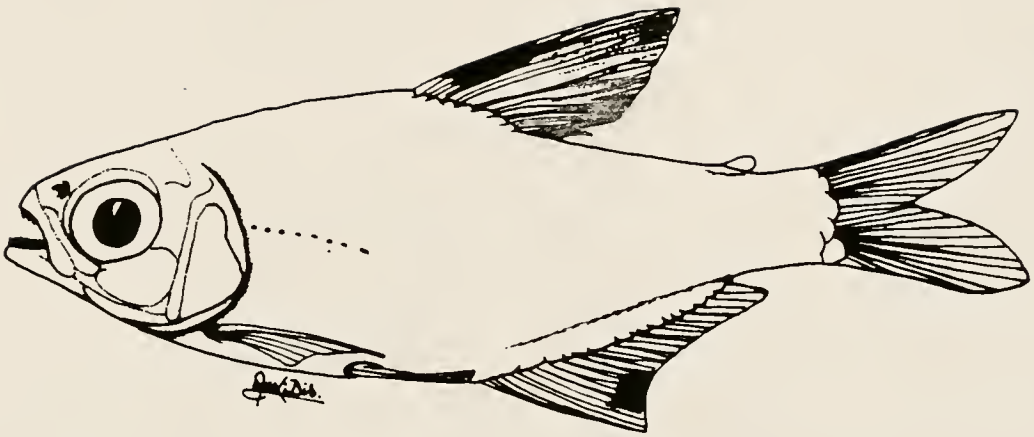
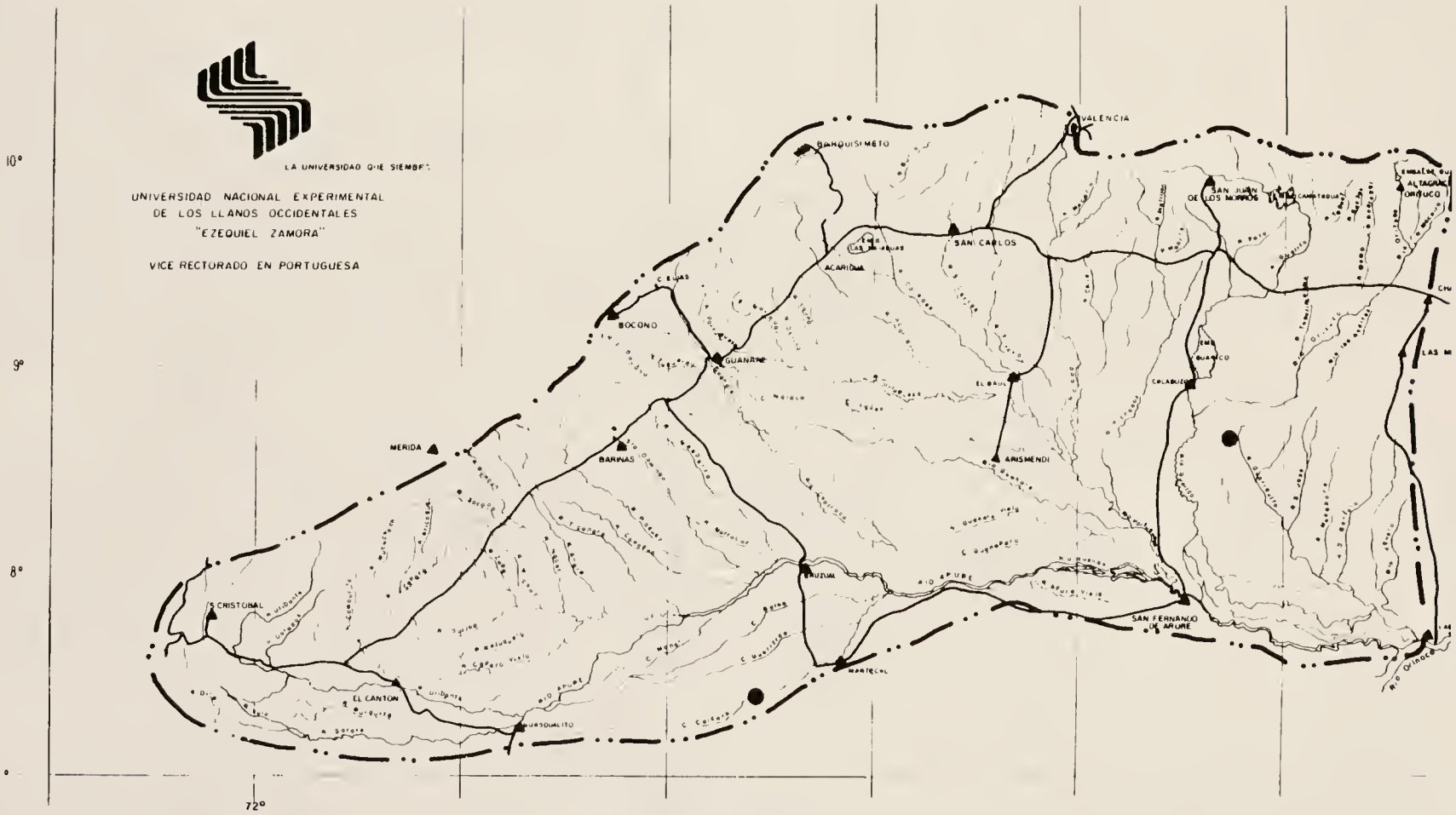


Figure 133. Hemigrammus cf elegans.

Figure 134. Apure drainage distribution of *Hemigrammus* cf *elegans*.



CUENCA DEL RIO APURE

Hyphessobrycon bentosi, but that species has a large, well-defined humeral spot, whereas H. elegans has none. Megalamphodus cf axelrodi is the most similar species, but it has conical (vs tricuspid) teeth.

Size. It grows to about 40 mm SL.

Morphology. It is somewhat elongate and compressed.

Counts. DR 11; AR 23-24; LS 30-33; TS 5 above, 3-4.5 below LL.

Pigmentation. The body is pale, with no humeral spot. The dorsal fin and sometimes the anal fin have a faint blotch of pigment on the first few rays. The pigment on the anal fin is either quite variable or fades rapidly in preservative.

Distribution and Natural History

Range. It is known from the Amazon and Orinoco basins.

Apure distribution. Map: fig. 134. It occurs in northern Apure state and in the Aguaro River system.

Habitat. It inhabits blackwater streams of the low llanos.

Abundance. UNCOMMON.

Number of specimens examined. 50 from 6 collections.

Food. OMNIVORE. It eats seeds, microcrustaceans, and insects.

Reproduction. Strategy: probably r1; see account of H. analis.

Importance. Ornamental.

Hemigrammus marginatus Durbin-Ellis 1911

Sardinita - Bassam Tetra

Fig. 45 (caudal pattern) & 135. Map: fig. 136. Couplet 60a.

Specific synonymy

Hemigrammus marginatus Durbin-Ellis 1911:159 pl.3, fig. 3 (type locality: Queimadas, Río Itapicurú [coastal drainage of southern Brazil, about 39° 11'S]), seen, Eigenmann 1920:10 (Lake Valencia,

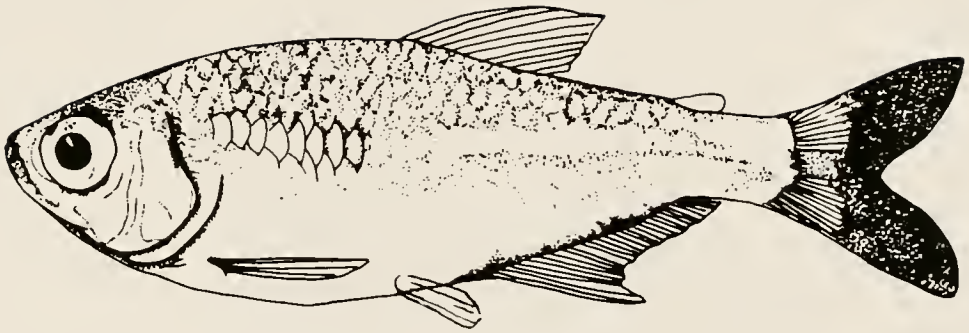


Figure 135. Hemigrammus marginatus.

Venez.) Pearse 1920:12; Eigenmann & Myers 1929:529 (questioned Eigenmann's identification of Lake Valencia specimens); Axelrod et al. 1971:F-322.05; Mago L. 1970:71; Géry 1977:442, 502, 521 (key).

Types. Holotype: FMNH 54430 (CM 3053), examined. Ibarra & Stewart (1987) report that 130 of the paratypes CM 3054-67, 3077, 3082-84 are also at FMNH.

Comments. Apure drainage specimens are very similar to the holotype, though the latter has lost all but a trace of the pigment in the tail. The holotype has the first nine lateral scales pored on left side, but only seven on the right. Its air bladder is two chambered, with the first only half as long as the posterior, which extends down almost to the anus.

Etymology. MARGINATUS = refers to the black margin of the caudal fin.

Description

Illustrations. Figs. 40b (caudal pattern) & 135; Durbin Ellis 1911: pl. 3, # 3 (holotype); Axelrod et al. 1971:F-322.05.

Diagnosis. In fresh material the caudal-fin pigmentation (fig. 40b) is diagnostic for this species when combined with the incomplete lateral line. It is easily confused (especially in old or faded material) with Hemigrammus sp. "arriba," but the latter species has dense pigment only in the upper caudal-fin lobe, and differs further in having fewer lateral scales (30-31 vs 32-34), fewer transverse scales (9-10 vs 11), and fewer scales around the caudal peduncle (10 vs 12-13).

Size. This fish grows to about 45 mm SL, but most individuals are smaller.

Morphology. The lateral line is incomplete, with only about eight perforated scales. The anal fin has a short sheath of scales

anteriorly. The tail has a few scales covering its base, in the largest specimens reaching more than 1/3 out length of rays.

Counts. DR ii9-ii10; AR iii19-iii22; LS 32-34; TS 11; CPS 13; teeth 4 or 5 in outer and inner row of premaxilla, none on maxilla, dentary with 4.

Measurements. HL about 27% SL; EYE about 43% HL.

Pigmentation. The dorsal fin is orange, red or yellow. The caudal fin is often similarly colored near its base but has a wide marginal or submarginal black band of pigment. The lateral stripe is silvery in life, leaden in preservative. The scales on the dorsum are outlined in gray, and the dorsal midline has a concentration of pigment. The belly is white. Some populations have a curving row of black dots arranged in groups of four that extends from the opercle out along the first nine scales of the incomplete lateral line. There is a concentration of melanophores on the body at the base of the first ten anal-fin rays.

Distribution and Natural History

Range. It occurs from Venezuela to Argentina.

Apure distribution. Map: fig. 136. It is very common throughout the lower portions of the drainage.

Habitat. It abounds in the quieter sections of streams, and is also common in standing water.

Abundance. COMMON.

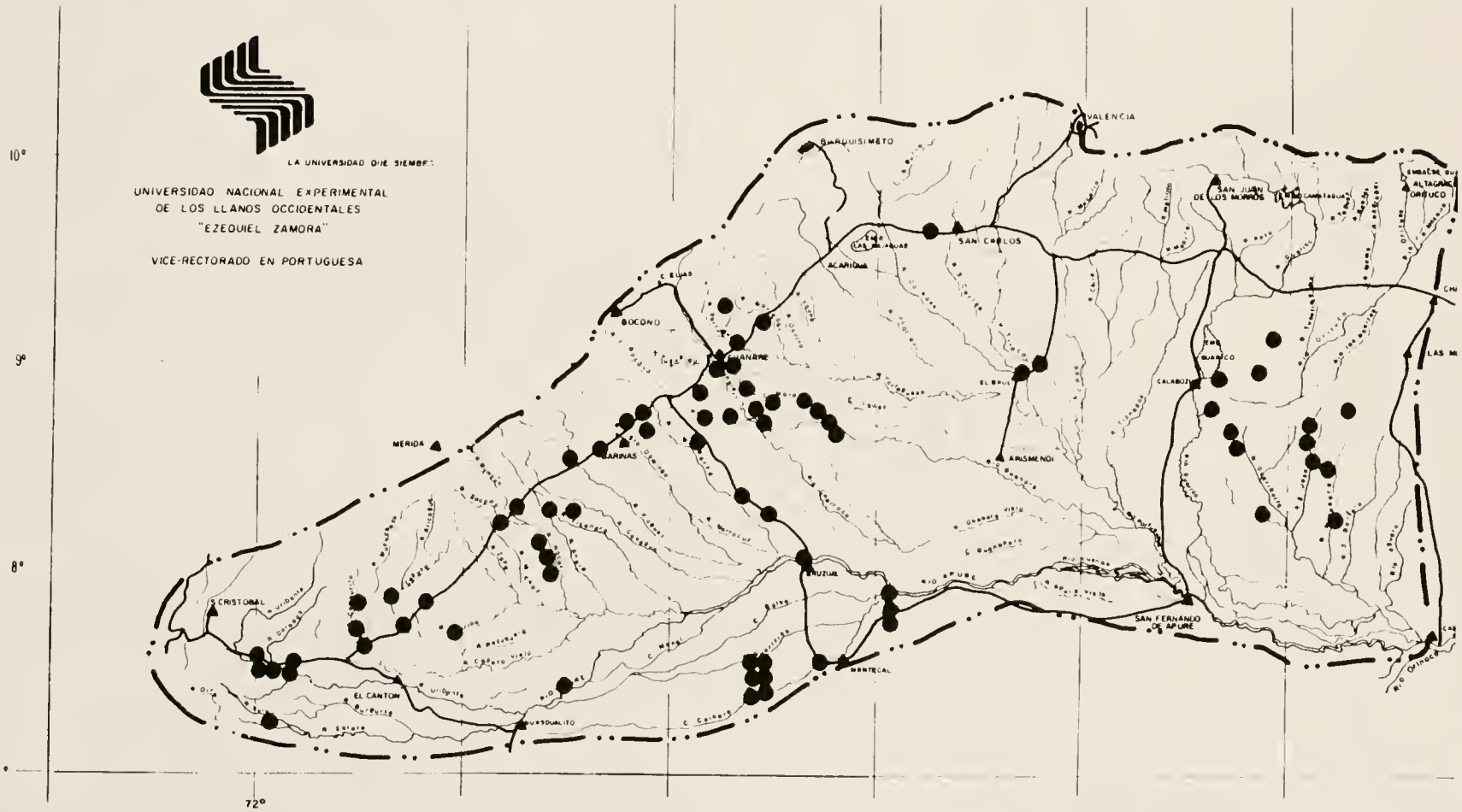
Number of specimens examined. 3,767 from 184 collections.

Food. OMNIVORE. Microcrustaceans, aquatic insects, terrestrial insects, seeds, and protozoa comprise the major items of this species diet (K. Winemiller, pers. com.).

Reproduction. Strategy: probably rl. see account of *H. analis*.

Importance. Ornamental.

Figure 136. Apure drainage distribution of *Hemigrammus marginatus*.



CUENCA DEL RIO APURE

Hemigrammus micropterus Meek 1907

Sardinita - Small-finned Tetra

Fig. 51b, c (caudal spot) & 137. Map: fig. 138. Couplet 71b.

Specific synonymy

Hemigrammus micropterus Meek in Eigenmann & Ogle 1907:13,15 (type locality: Los Castillos, Venezuela), seen; Eigenmann 1918:150 (key); Fowler 1931:408 (Pitch Lake at Guanoco, Venez.); Mago L. 1970:71; Géry 1977:495 (key).

Types. Holotype: CAS 44438 (IU 10802).

Comments. Hitherto known only from the type specimen.

Etymology. MICRO= small, PTERUS = fin.

Description

Illustrations. Figs. 51b, c (caudal spot) & 137. Eigenmann 1918:pls. 18 & 78.

Diagnosis. The large, triangular caudal spot is the distinguishing feature of this species. The spot is usually not united with the lateral stripe, but continues to the tips of the central caudal-fin rays.

Size. It grows to about 40 mm SL.

Morphology. The lateral line is incomplete, with the line of 8-10 pored scales reaching back to the tips of the depressed pectoral-fins, or just reaching insertions of pelvic fins. There are only a few scales on the caudal-fin base.

Counts. DR 11; AR 19-21; LS 28-33; Premaxilla with 5-6 multicuspid teeth in inner row, the central 2 asymmetrical, 3-4 in outer row; maxilla with one 7-pointed tooth.

Measurements. BD 3.2 to 4.0 in SL.

Pigmentation. See diagnosis.

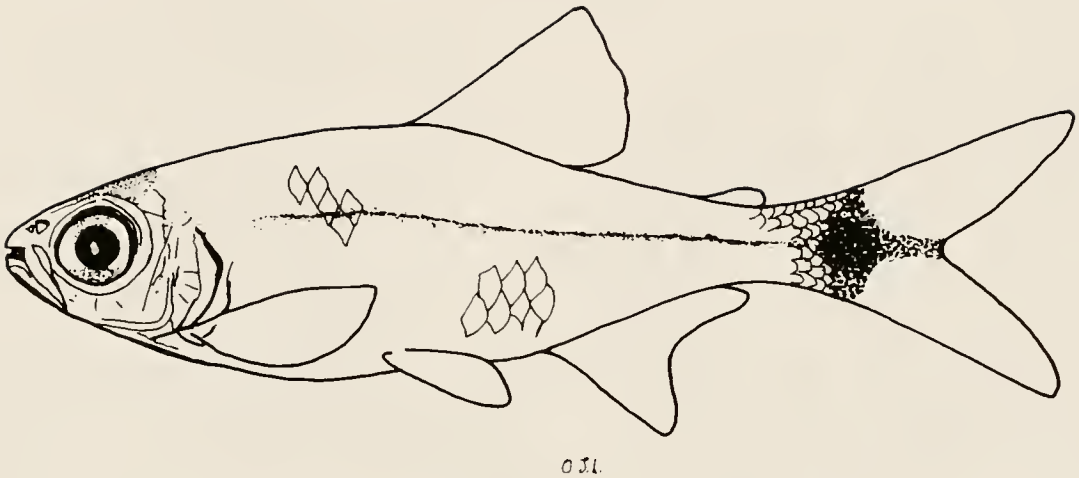
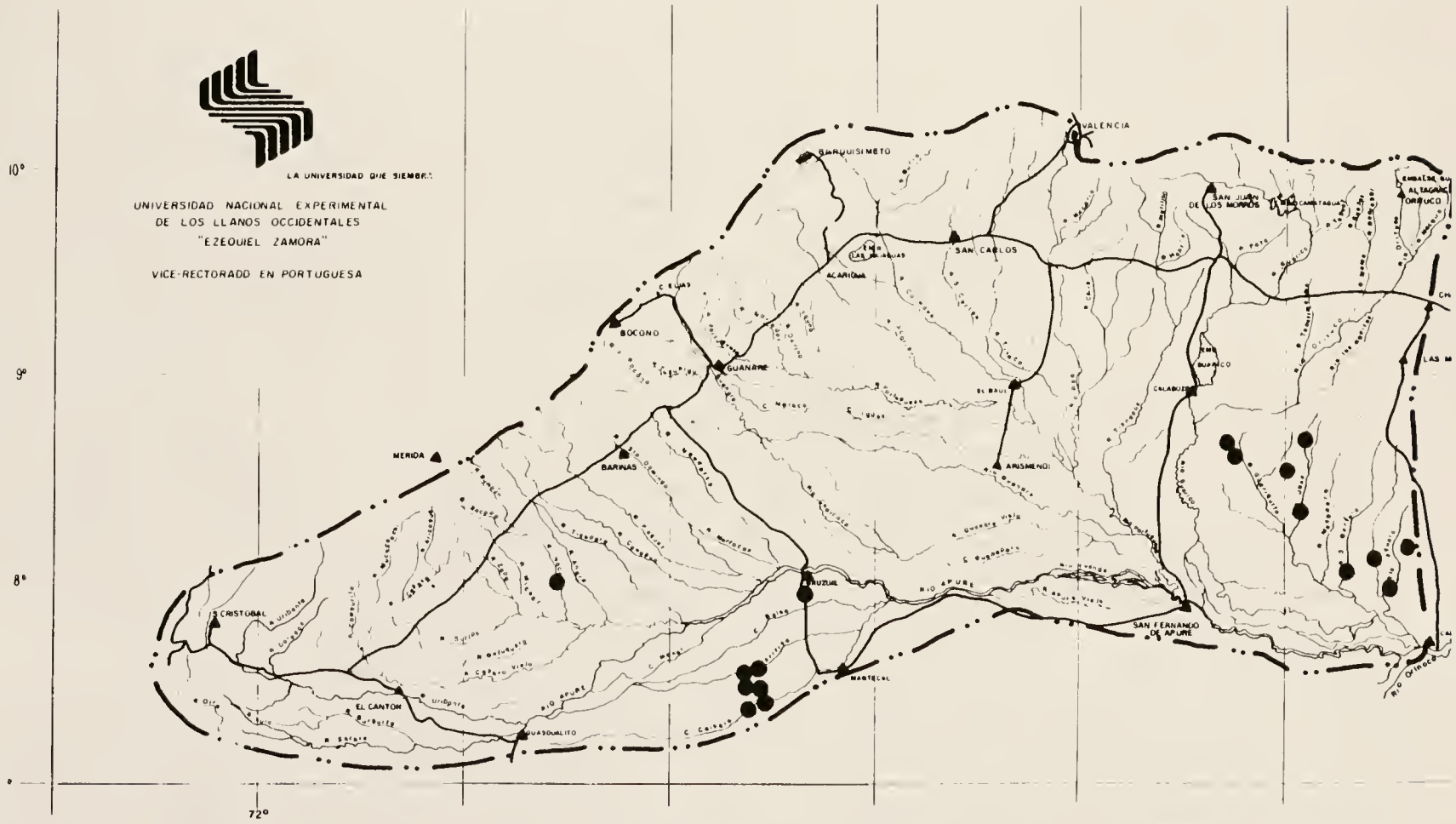


Figure 137. Hemigrammus micropterus.

Figure 138. Apure drainage distribution of *Hemigrammus micropterus*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 138. This species is most commonly taken from northern Apure state, from the Aguaro River system in the southeasternmost part of the drainage, and in Barinas in the Suripá system.

Habitat. Blackwater streams of the sandy-soiled savanna, with aquatic vegetation are its preferred habitat.

Abundance. COMMON.

Number of specimens examined. 2,096 from 37 collections.

Food. OMNIVORE. It feeds on seeds, microcrustaceans, and insects.

Reproduction. Strategy: probably r1; see account of *H. analis*.

Importance. Ornamental.

Hemigrammus microstomus Durbin 1910

Sardinita - Small-Mouthed Tetra

Fig. 139. Map: fig. 140. Couplet 66b.

Specific synonymy

Hemigrammus microstomus Durbin *in* Eigenmann 1910:436 (type locality: Río Amazonas), seen; Mago L. 1970:71; Géry 1977:494, 499.

Etymology. MICRO = small, STOMUS = mouth.

Types. Holotype: MCZ 20782. Paratypes: MCZ 20782 & 20783 (19), 20840(5), CAS 42680.

Description

Illustrations. Fig. 139; Durbin *in* Eigenmann 1910:pl. 3. Durbin-Ellis 1911:pl. 8.

Diagnosis. Pigmentation pattern is the best guide to the identity of this species. The humeral spot is distinctly rounded and somewhat small, a faint, diffuse lateral stripe extends from it back to the caudal

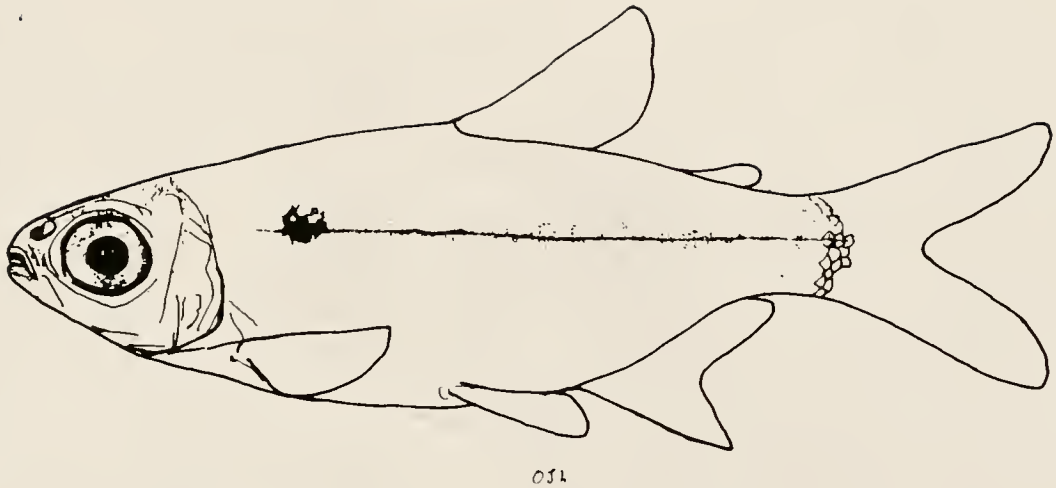


Figure 139. Hemigrammus microstomus.

peduncle. The rest of the fish is plain, silvery to whitish. There are 2-3 teeth on the maxilla. The lateral line is incomplete, with about ten pored scales extending posteriorly to just beyond the tip of the pectoral fin.

Size. It grows to about 40 mm SL.

Morphology. see diagnosis.

Counts. DR 11; AR 21; LS 31-34; TS 5 above, 3 below LL; premaxilla with 5 seven cuspid teeth in inner row, 2 in outer row; maxilla with 2-3 multicuspid teeth; GR 7.

Measurements. Eye 2.25 in HL, about equal to interorbital; HL 3.6 to 4 in SL; GBD 2.8-3.5 in SL.

Pigmentation. The fins are all hyaline.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 140. It has so far been found only in the Aguaro River system in the southeastern corner of the Apure River drainage.

Habitat. Blackwater streams of the savanna, with aquatic vegetation are this species primary habitat.

Abundance. UNCOMMON.

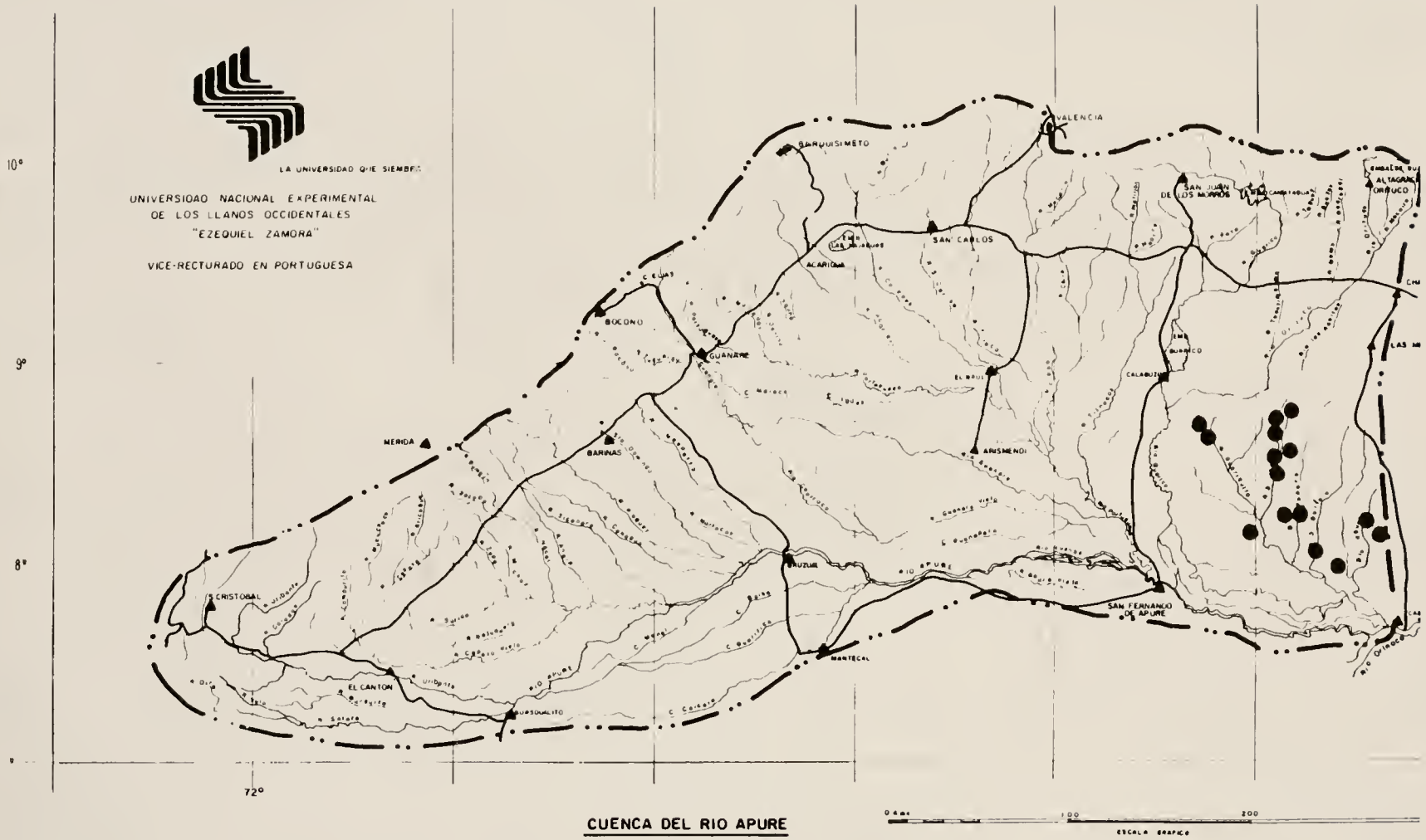
Number of specimens examined. 594 from 16 collections.

Food. OMNIVORE. It feeds on a variety of foods including seeds, microcrustaceans, and insects.

Reproduction. Strategy: Although no data are available this species is probably an r1 strategist like most small tetras. Most *Hemigrammus* spp. are egg scatterers, see the account for *H. analis*.

Importance. Ornamental.

Figure 140. Apure drainage distribution of *Hemigrammus microstomus*.



CUENCA DEL RIO APURE

Hemigrammus cf mimus Böhlke 1955

Sardinita Mima - Mimic Tetra

Fig. 46 (caudal pattern) & 141. Map: fig. 142. Couplet 63a.

Specific synonymy

Hemigrammus mimus Böhlke 1955a:229 (type locality: rapids at Camanáos on the Río Negro, Brazil (down river from São Gabriel); Géry 1977:490.

Types. Holotype: CAS 47759. Paratypes CAS 47760(1).

Comments. I have called this species H. mimus because Apure drainage specimens share the color pattern of that species. However, the teeth and anal-fin ray counts differ. Subsequent study may show them to be related to H. erythrozonus.

Etymology. MIMUS = mimic, referring to the similarity between this species and the species of Microschemobrycon, with which Böhlke originally confused it.

Description

Illustrations. Fig. 46 (caudal pattern) & 141; Böhlke 1955:232.

Diagnosis. The small embedded crescent of pigment at the base of each caudal lobe and the small size are both diagnostic of this species. Microschemobrycon casiquiare share this pigment pattern, but have the premaxillary teeth in a single row, and is more slender (GBD 3.7-4.6 in SL).

Size. This is a tiny species which seldom exceeds 30 mm SL.

Morphology. The body is nearly subcylindrical with the greatest body depth found at the dorsal-fin origin. Males have minute hooks on the anal and caudal-fin rays.

Counts. DR ii9; AR 17 in type series, but 19 in Apure specimens; PR i11; VR i7; LS 32, lateral line pores 9-11; TS 8; predorsal scales

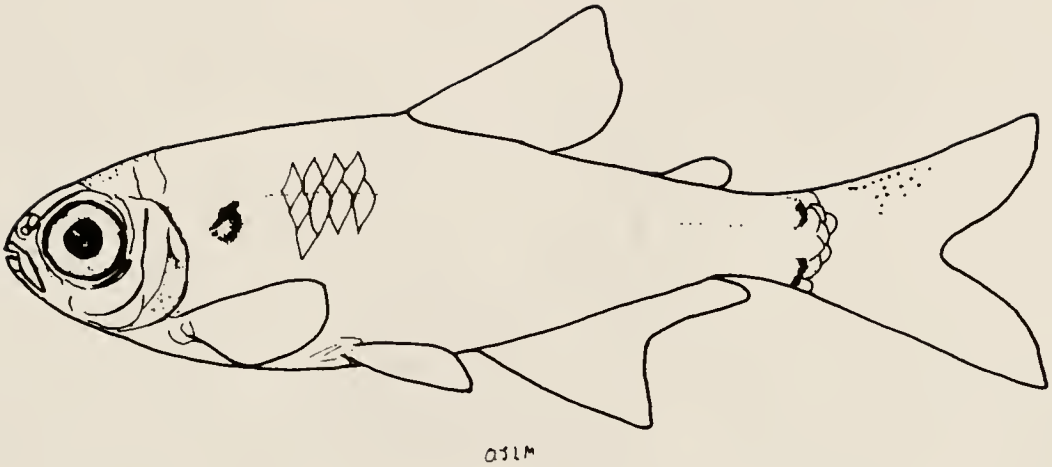
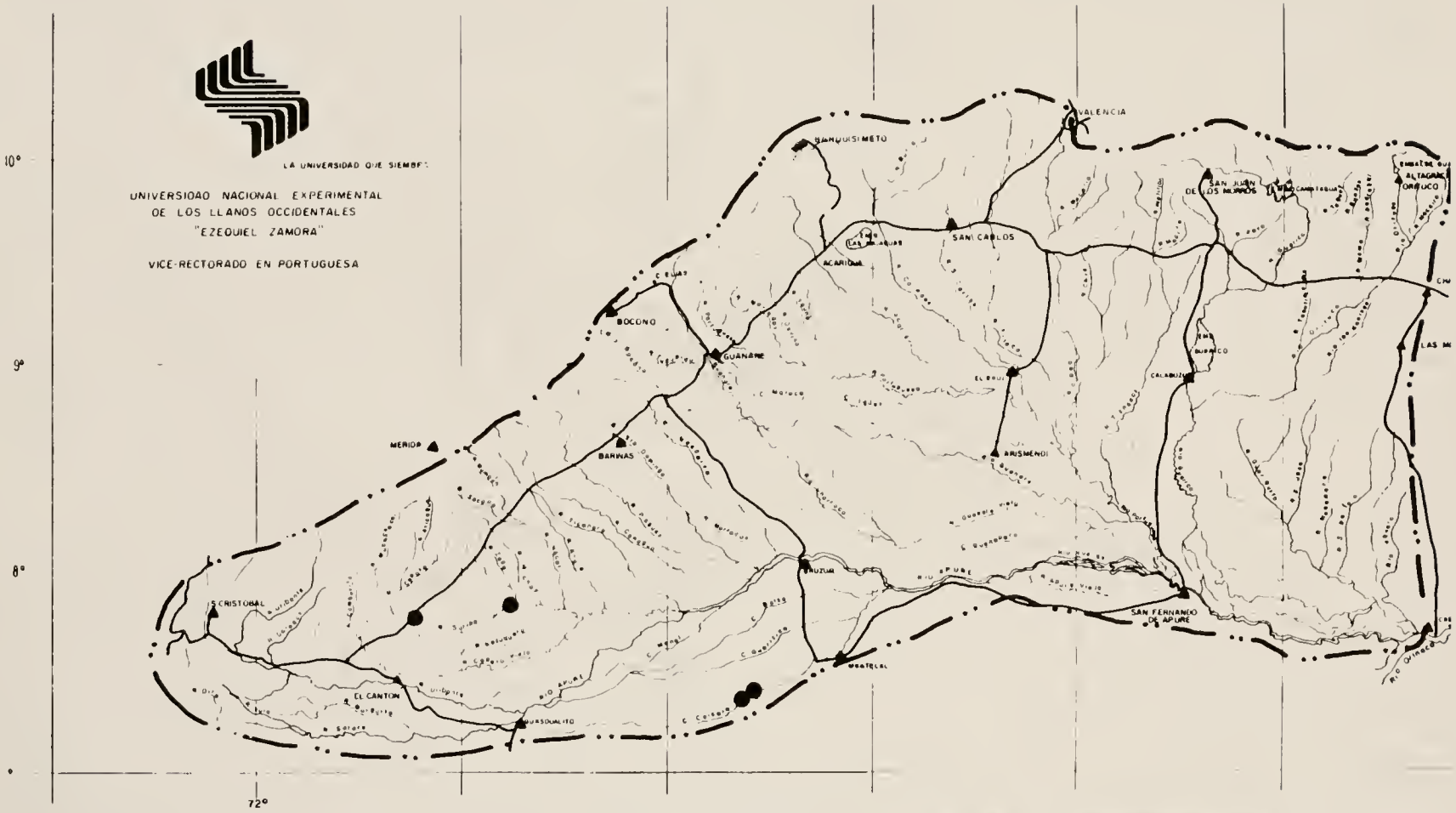


Figure 141. Hemigrammus cf mimus.

Figure 142. Apure drainage distribution of *Hemigrammus* cf *mimus*.



CUENCA DEL RIO APURE

8-9; premaxillary teeth in two rows, inner with 5-6, outer with 2-3 teeth (said to have but a single tooth in type series in this outer row), 3-4 slender tricuspid teeth on maxilla; GR 10-11.

Measurements. GBD 3.5-3.6 in SL; HL 3.7 in SL; EYE 2.8-2.9 in HL.

Pigmentation. The body is tan, with the embedded pigment at the base of each caudal lobe (fig. 41) the only marking.

Distribution and Natural History

Range. This species occurs in the Río Negro in Brazil, the upper Río Orinoco Basin in Venezuela and Colombia.

Apure distribution. Map: fig. 142. This species is found only in northern Apure state and Barinas.

Habitat. H. cf mimus occurs in sandy savannas, in clear and blackwater streams.

Abundance. RARE.

Number of specimens examined. 125 from 4 collections.

Food. OMNIVORE. It eats seeds, microcrustaceans, and insects.

Reproduction. Strategy: probably r1; see account of H. analis.

Hemigrammus newboldi (Fernández Y.) 1949

Sardinita Manchada - Spotted Tetra

Fig. 49 (caudal spot) & 143. Map: fig. 144. Couplet 68a.

Specific synonymy

Ramirezella newboldi Fernández Yépez 1949:1-3 (type locality: Palital, Guárico state, Venezuela), seen; Mago L. 1970:71; Géry 1977:458, 487.

Comments. The description of a new genus for this species seems totally unwarranted. There are no characters that justify the creation of Ramirezella, and so it should be considered as a synonym of Hemigrammus. However, placement of H. newboldi could be with either Hemigrammus or

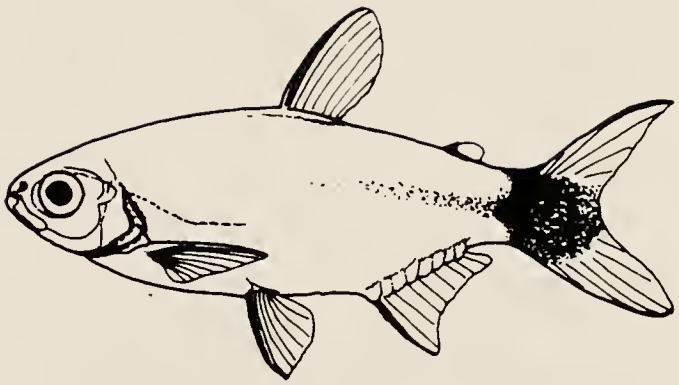


Figure 143. Hemigrammus newboldi.

Moenkhausia. As Eigenmann (1918) pointed out, specimens of Moenkhausia continho show a complete gradation from an incomplete to a complete lateral line. Both Hemigrammus and Moenkhausia, have scaled caudal fins. Fernández Y. (1949) stated that the basal fourth of the caudal fin is scaled in R. newboldi. Géry (1977) pointed out that this species is very similar to Moenkhausia cotinho, and I agree. It is quite possible, then, that H. newboldi is not distinct at the specific level either, but rather is a junior synonym of M. cotinho. A direct comparison with specimens of that species from Guyana is necessary to make the final determination.

Etymology. NEWBOLDI = after Mr. Philip Newbold, a friend of A. Fernández Y., who died while working on experiments on Lake Maracaibo, in 1948.

Description

Illustrations. Fig. 49 (caudal spot) & 143; Fernández Y. 1949: fig 1.

Diagnosis. The large caudal spot (covering most of the caudal peduncle and at least the basal third of the caudal fin) is characteristic of this species.

Size. It grows to about 50 mm SL.

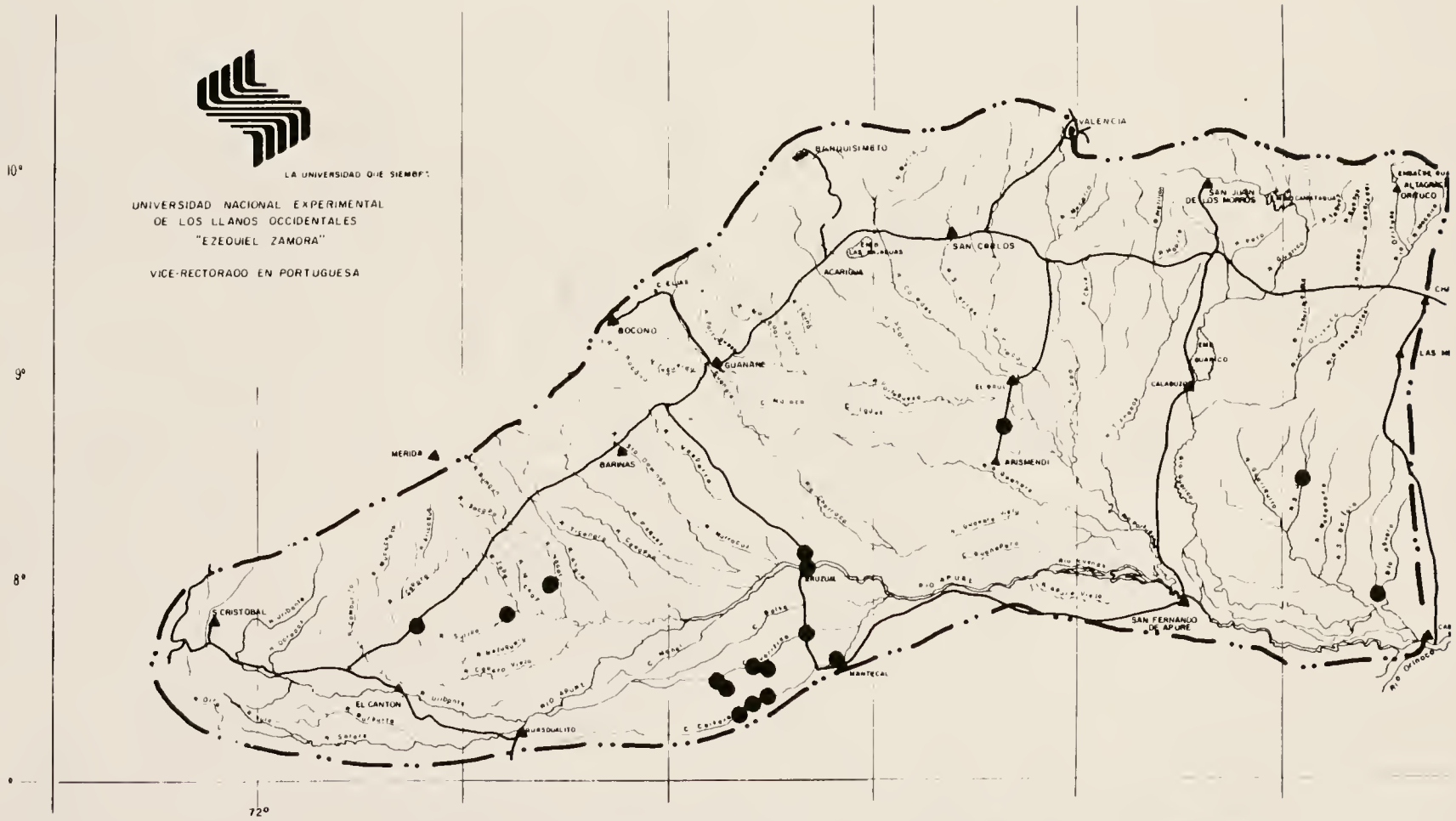
Morphology. The lateral line is incomplete, with 8-10 pored scales that extend posteriorly to just beyond the pelvic-fin insertions.

Counts. DR ii9; AR iii18-iii19; LS 28-30; TS 10; 5 teeth in inner row of premaxilla, 4 in outer;

Measurements. HL 4.0 in SL; GBD 2.8 in SL.

Pigmentation. In preservative, it is tan with a black lateral stripe starting under the dorsal fin. The caudal peduncle and base of tail have a very large black blotch that usually covers most of the caudal peduncle and at least the basal third of the caudal fin. The humeral spot is diffuse.

Figure 144. Apure drainage distribution of *Hemigrammus newboldi*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 144. So far this species has been found only in the Aguaro River system in the southeastern corner of the Apure drainage.

Habitat. Blackwater streams with aquatic vegetation are its primary habitat.

Abundance. UNCOMMON.

Number of specimens examined. 252 from 23 sites.

Food. OMNIVORE. It eats seeds, microcrustaceans, and insects.

Reproduction. Strategy: probably rl; see account of *H. analis*.

Importance. Ornamental.

Hemigrammus rhodostomus Ahl 1924

Borachito - Rummy-Nosed Tetra

Fig. 45a (caudal pattern) & 145. Map: fig. 146. Couplet 59a.

Specific synonymy

Hemigrammus rhodostomus Ahl 1924 (type locality: Pará, Brazil) seen; Ramírez (1960); Géry 1977:502, 520, 547, 550; Axelrod et al. 1971:F-324.00; Mago L. 1970:71.

Comments. The Venezuelan specimens could represent a new species, since they differ slightly in color (Apure drainage and Capanaparo drainage specimens have an orange to red caudal peduncle and caudal fin in life) and have one small maxillary tooth. To be certain, however, they will have to be compared with material of *H. rhodostomus* from other basins, as well as *H. bleheri* Géry & Mahnert 1986 from the middle Río Negro in Brazil.

Etymology. RHODO = red; STOMUS = mouth.

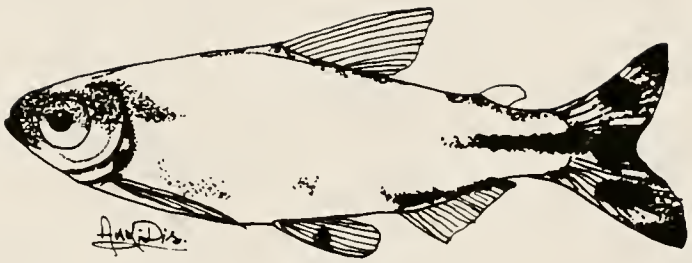


Figure. 145. Hemigrammus rhodostomus.

Description

Illustrations. Fig. 45 (caudal pattern) & 145; Axelrod et al. 1971:F-324.00 Géry 1972:31, 90, 92, 93, 94; 1977:520; Géry & Mahnert 1986:44.

Diagnosis. The distinctive pigmentation of this species immediately identifies them. The nose is red, and the caudal fin is marked with white and black bands (fig. 45A).

Size. It grows to about 50 mm TL.

Morphology. The body is slender, and not too compressed.

Counts. DR ii9; AR iii12-13; PR i11-12; VR i7; LS 32-33 (9 pored); TS 9.

Measurements. GBD 26-28% SL.

Pigmentation. The body is light tan in preservative, silvery to greenish in life. The upper and lower edges of the caudal peduncle are marked with a black line or spot. The snout is blood-red. The caudal fin is most distinctive, with white lobes crossbanded with black (fig. 45a).

Distribution and Natural History

Range. It has been found in the lower Amazon region, around Aripiranga and Para, and in the Orinoco Basin.

Apure distribution. Map: fig. 146. It is found only in the Aguaro River system in the southeastern corner of the Apure drainage.

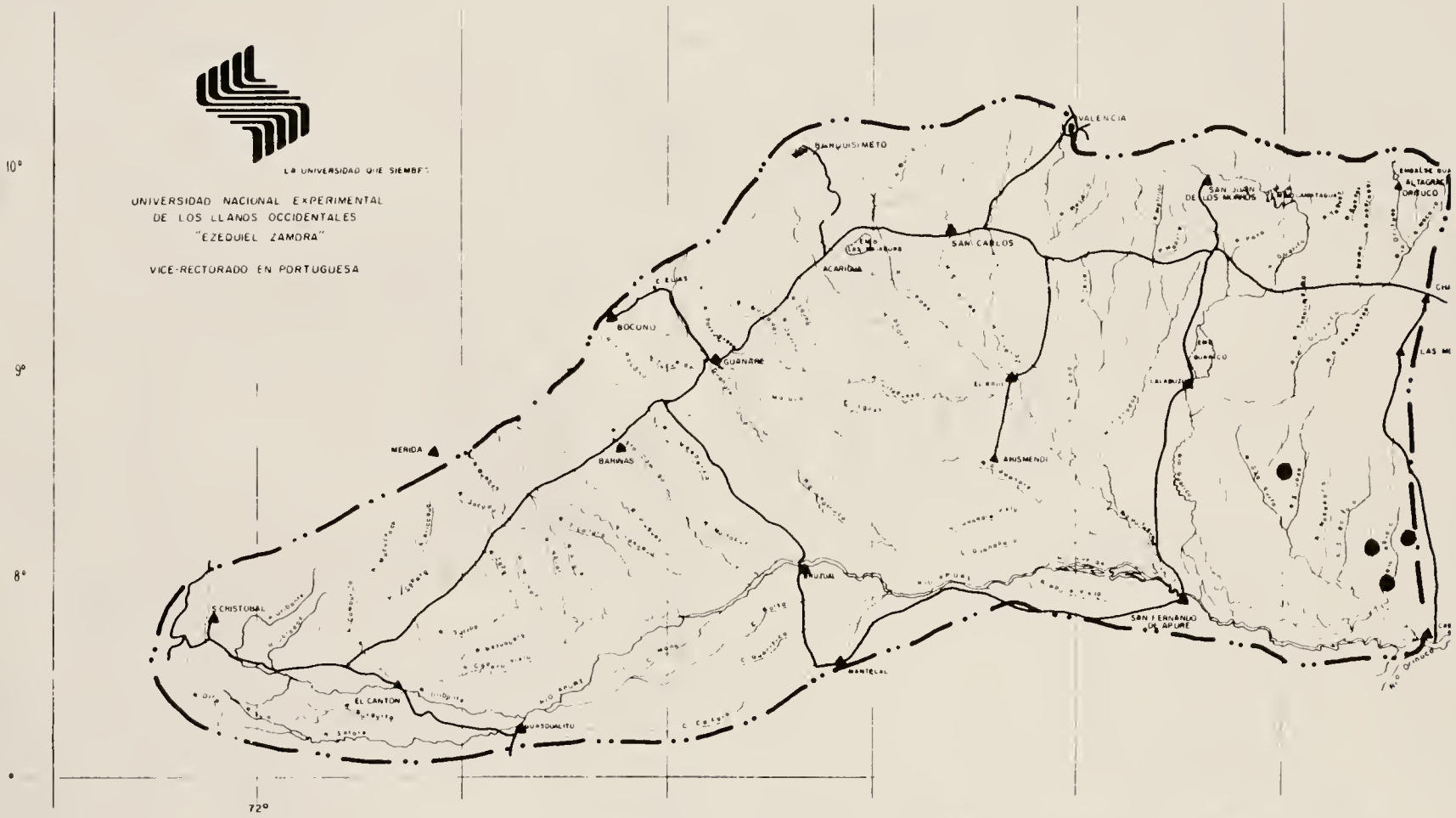
Habitat. It inhabits blackwater savanna streams, in areas with sandy soils.

Abundance. RARE.

Number of specimens examined. 116 specimens, 4 collections.

Food. OMNIVORE. It eats seeds, microcrustaceans, and insects.

Figure 146. Apure drainage distribution of *Hemigrammus* cf *rhodostomus*.



CUENCA DEL RIO APURE

Reproduction. Strategy: probably rl. Palicka (1989) reported on this species' unusual spawning behavior. H. rhodostomus do not scatter eggs in the usual characid fashion, but rather hang their adhesive eggs from plants near the surface. Water chemistry was of utmost importance to induce spawning also for the successful development of the embryos, and fry. They require low ph (5-6) soft (about 40 mS conductivity) water stained to tea-color with peat moss, and from which most calcium has been chemically removed. No sort of water contamination is tolerated by this species. They will go into shock and die if water conditions are allowed to deteriorate. Light must be reduced to a minimum. Spawning occurs at night, eggs are transparent and about 1 mm in diameter. A pair can deposit from 400-500 eggs per spawning. The fry are rather large, about 3.9 mm when they have absorbed the yolk, and can immediately feed on brine shrimp nauplii. They grow quickly, reaching 10 mm in one week if properly fed. They mature in six to seven months.

Importance. It is highly valued as an ornamental.

Hemigrammus cf schmardae (Steindachner) 1882

Sardinita - Tetra

Fig. 51a (caudal spot) & 147. Map: fig. 148. Couplet 71a.

Specific synonymy

Tetragonopterus schmardae Steindachner 1882:37 pl. vii, fig. 6 (type Locality: Tabatinga, Brazil), not seen.

Hemigrammus schmardae Fowler 1906:335 (Peruvian Amazon) not seen; Eigenmann 1910:436; 1918:163 (key); Géry 1977:506, 524, 601.

Comments. Eigenmann (1918) did not mention a black line along the base of the anal fin. This character is so obvious that it would hardly have been overlooked if present in his Amazonian specimens. His figure

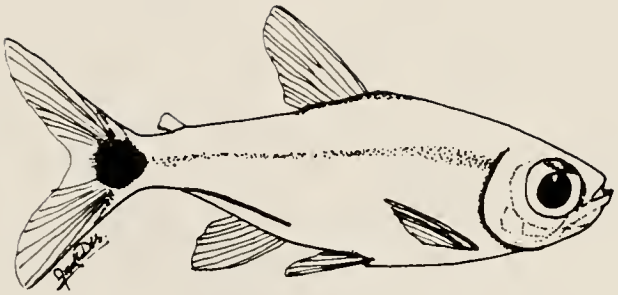


Figure 147. Hemigrammus cf schmardae.

also represents a much deeper-bodied fish than those seen in the Apure drainage. I suspect, therefore, that my identification of this species is incorrect. It probably represents a new species.

Etymology. SCHMARDAE = origin unknown.

Description

Illustrations. Fig. 51a (caudal spot) & 147. Eigenmann 1918:pls. 20, 78; Géry 1977:524.

Diagnosis. The small size, relatively large rounded caudal spot, the absence of a humeral spot, and the black line along the base of the anal fin are the best clues to the identity of this species.

Size. It is a small species that only rarely reaches 40 mm SL.

Morphology. The lateral line is incomplete, with about 12 pored scales that extend posteriorly to over the middle of the depressed pelvic fins.

Counts. AR 20; LS 31; premaxilla with 5 pentacuspid teeth in inner row, 3 in outer; maxilla with 2 pentacuspid teeth.

Measurements. BD 3.4 to 4.0 in SL.

Pigmentation. There is no humeral spot. The base of the anal fin is marked with a black line. The caudal spot is quite large, covering most of peduncle (fig. 51a).

Distribution and Natural History

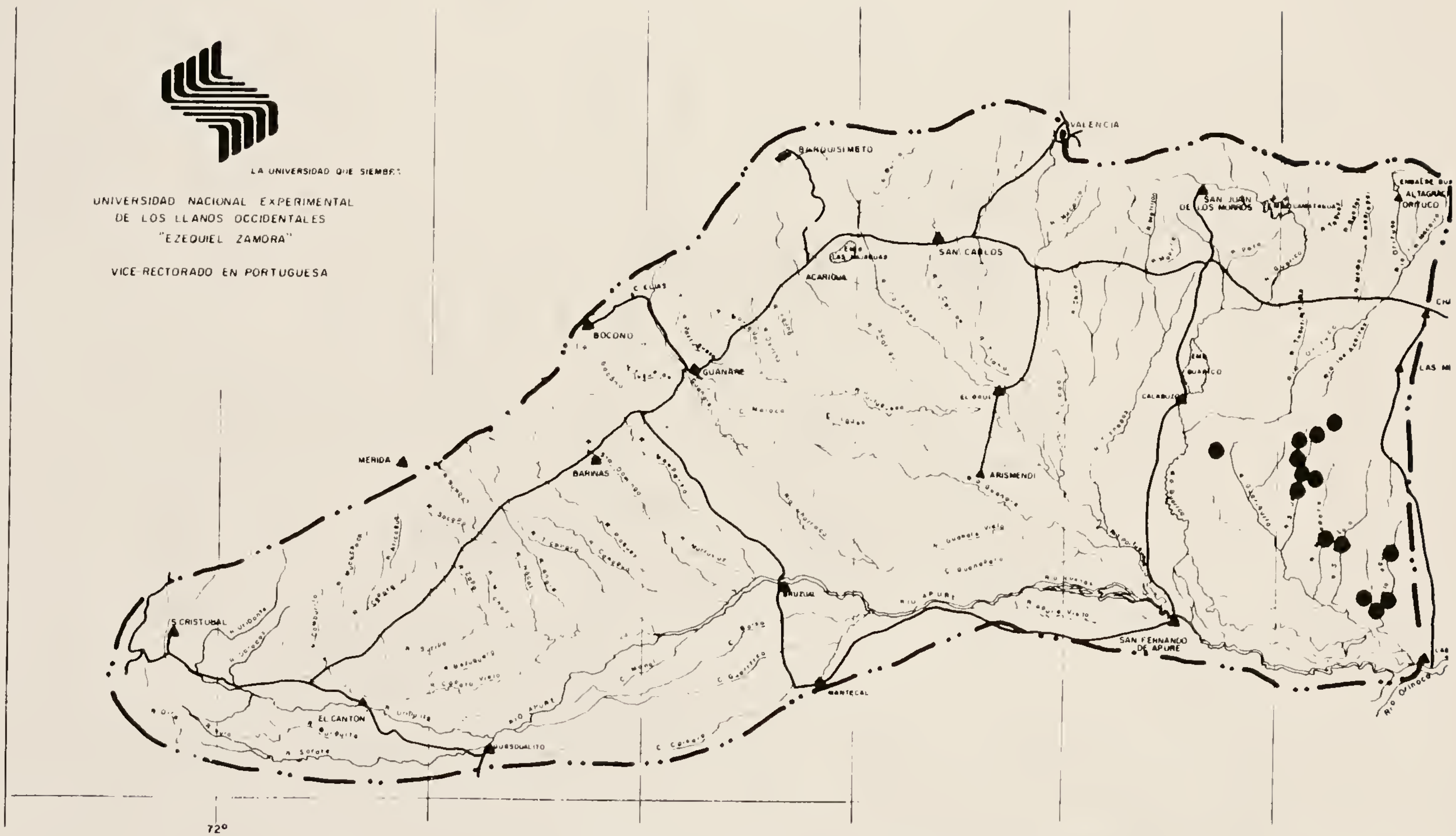
Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 148. This species has been found only in the Aguaro River system in the southeastern corner of the Apure drainage.

Habitat. H. cf schmardae inhabits blackwater savanna streams with aquatic vegetation.

Abundance. UNCOMMON.

Figure 148. Apure drainage distribution of Hemigrammus cf schmardae.



CUENCA DEL RIO APURE

Number of specimens examined. 607 from 16 collections.

Food. OMNIVORE. It eats small seeds, microcrustaceans and insects.

Reproduction. Strategy: probably r1; see account of H. analis.

Importance. Ornamental.

Hemigrammus sp. "arriba"

Sardinita - Tetra

Fig. 45c (caudal pattern) & 149. Map: fig. 150. Couplet 60b.

Comments. This species is very similar to, but clearly distinct from H. marginatus. It is also similar to H. rodwayi, a common species in eastern Venezuela, but that species has the lateral stripe continuing onto the central caudal rays without interruption, and also has very different nuptial coloration. The Apure specimens probably are a new species.

Description

Illustrations. Figs. 45c (caudal pattern) & 150.

Diagnosis. This fish looks like a Hemigrammus marginatus which has black pigment only in the upper lobe of the caudal fin. The eye is relatively smaller than in H. marginatus. See the diagnosis for that species.

Size. It reaches about 40 mm SL.

Morphology. The lateral line is incomplete, and has about eight pored scales. The anal fin has a short sheath of scales anteriorly.

Counts. DR ii9; AR iii20-22 ; PR 10-11; VR i6; LS 30-31; TS 9-10; CPS 10; teeth variable on premaxilla, 3 to 5 in outer row, 2 to 5 in inner, none on maxilla.

Pigmentation. Some specimens have yellow near base of the caudal fin. The upper lobe of the caudal fin is marked with an upswept black bar (fig. 149), (the caudal fin is actually finely peppered with tiny melanophores

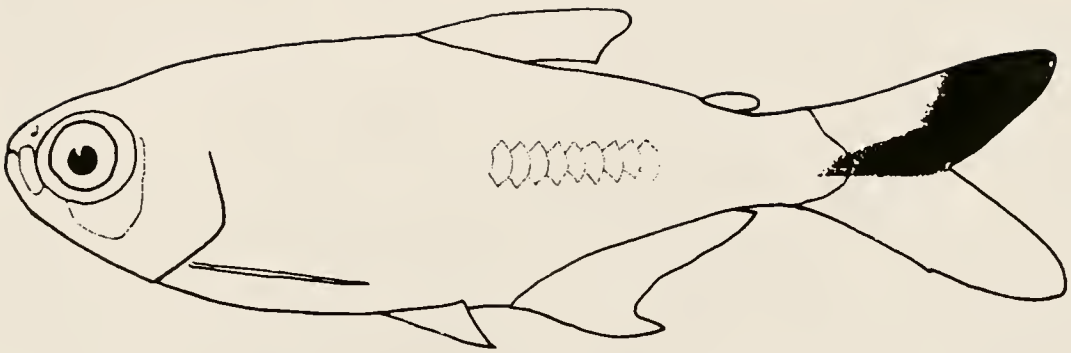
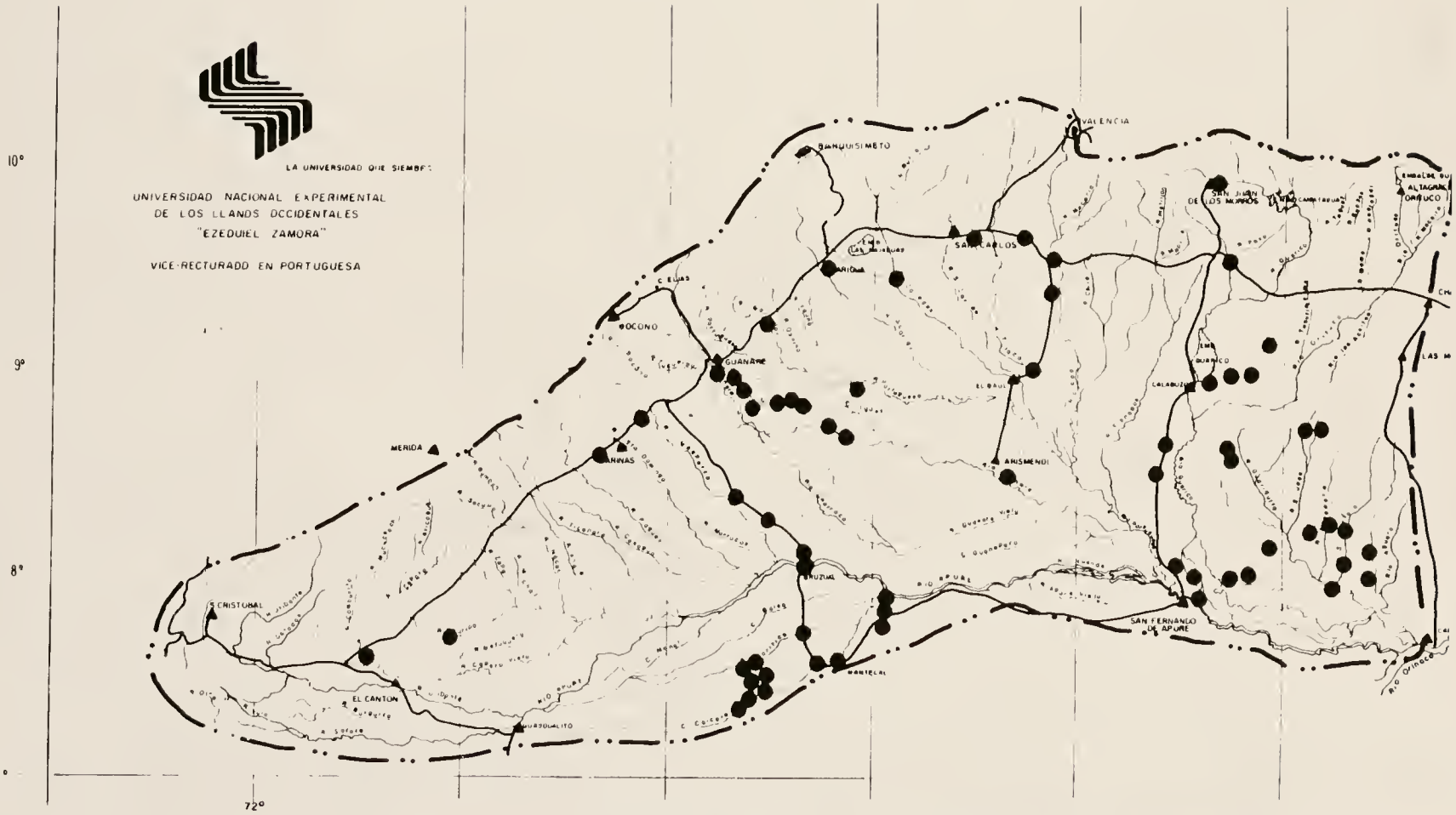


Figure 149. Hemigrammus sp. "arriba".

Figure 150. Apure drainage distribution of *Hemigrammus* sp. "arriba".



CUENCA DEL RIO APURE

that are most dense in the dorsal lobe). The dark lateral stripe does not continue onto the caudal fin. There is an irregular patch of small black spots on the body over the origin of the anal fin. Black and yellow pigment is concentrated along the rays of the anal fin.

Distribution and Natural History

Range. It is apparently limited to the Orinoco Basin.

Apure distribution. Map: fig. 150. It is common in the llanos.

Habitat. It inhabits the lowland llanos and piedmont streams and ponds.

Abundance. COMMON.

Number of specimens examined. 4,733 from 149 collections.

Food. OMNIVORE. It eats aquatic and terrestrial insects, seeds, and microcrustaceans.

Reproduction. Strategy: probably rl; see account of *H. analis*.

Importance. Ornamental.

Hemigrammus stictus (Durbin) 1909

Sardinita Flamante - Flaming Tetra

Fig. 151. Map: fig. 152. Couplet 65b.

Specific synonymy

Hyphessobrycon stictus Durbin 1909:71 (type locality: Lama Stop-Off, British Guiana), seen; Eigenmann 1910:437; 1912:342; 1921:216; Böhlke 1953a:25.

Hemigrammus stictus Géry 1977:490, 491, 505, 508 (key).

Types. Holotype: FMNH 52798 (CM 1197). Paratypes: CAS-SU 21923(3) 21922(2); 146 from 5 collections in FMNH.

Comments. I have not compared Apure material with specimens from Guyana.

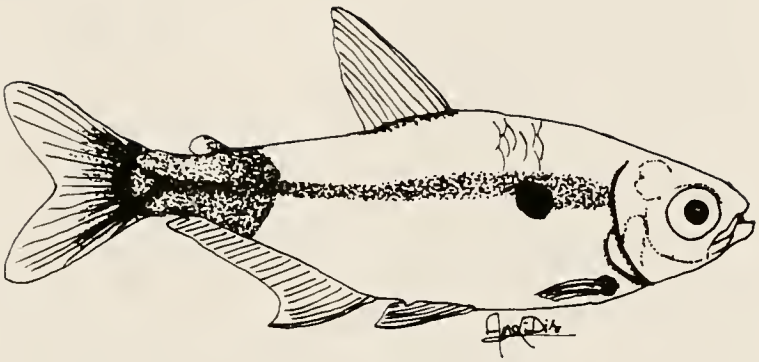


Figure. 151. Hemigrammus stictus. The stippling in the posterior portion of the body amd the caudal fin indicates the area that is red in life.

Etymology. STICTUS = marked or spotted, probably in reference to the distinct humeral spot.

Description

Illustrations. Fig. 151; Eigenmann 1918:pl. 22 fig. 1; Géry 1977:505, 508.

Diagnosis. The brilliant scarlet to cherry-red color on the posterior portion of the body is diagnostic for freshly preserved or live specimens. The humeral spot is round, intense, and often surrounded by a pale area. There is no black caudal spot. It has more pored scales in the lateral line (about 15) than most species of Hemigrammus.

Size. It can reach about 40 mm SL.

Morphology. The lateral line is incomplete, with about 15 pored scales that extend almost to the pelvic-fin origins.

Counts. DR 11; AR 26-31; LS 33-35; TS 6 above LL, 4 below; PDS 9-11; premaxilla with 5 teeth in inner and 2-3 in outer row; maxilla with 2 wide multicuspid teeth; GR 11.

Measurements. HL 3.5-3.8 in SL; GBD 2.75-3.25; EYE 2.25 in HL; snout one half of eye; interorbitals less than the eye, about 2.5 in HL.

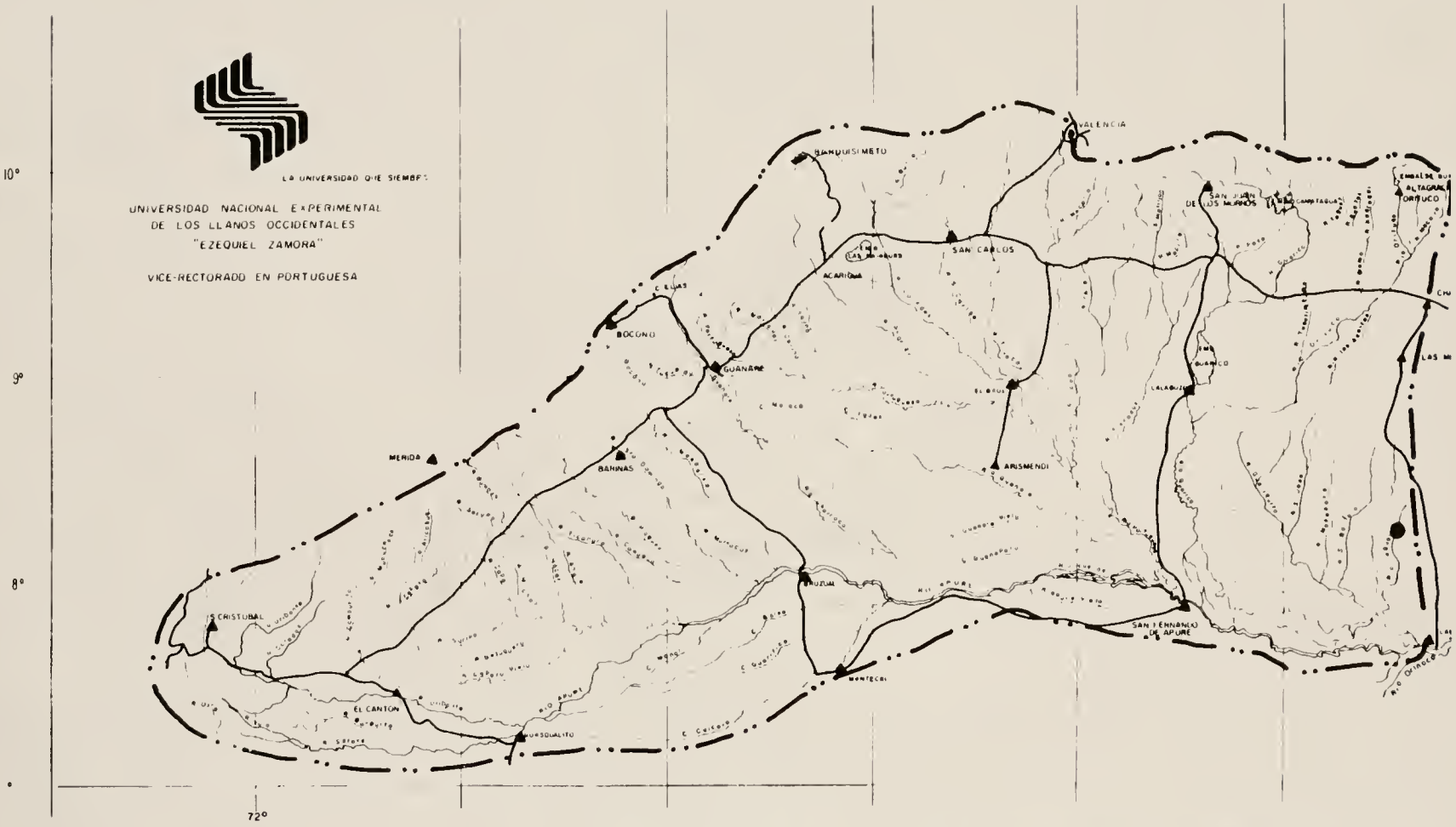
Pigmentation. See diagnosis. The body is silvery to whitish. The lateral stripe is very thin and does not reach the caudal-fin. The lobes of the caudal, dorsal and anal fins are yellowish.

Distribution and Natural History

Range. It is known from Guyanan rivers, the Orinoco Basin and the Río Guainía (upper Río Negro) in Venezuela.

Apure distribution. Map: fig. 152. It has been found only in the Aguaro River system in the southeastern corner of the Apure drainage.

Figure 152. Apure drainage distribution of *Hemigrammus stictus*.



CUENCA DEL RIO APURE

Habitat. H. stictus inhabits blackwater savanna streams with aquatic vegetation.

Abundance. RARE.

Number of specimens examined. 1 specimen.

Food. OMNIVORE. It eats seeds, microcrustaceans, and insects.

Reproduction. Strategy: probably r1; see account of H. analis.

Importance. Ornamental.

Heterocharax macrolepis Eigenmann 1912

Sardinita dientudo

Fig. 153. Map: 154. Couplet 9a.

Generic synonymy

Heterocharax Eigenmann 1912:405. (type species: Heterocharax macrolepis, by original designation).

Specific synonymy

Heterocharax macrolepis Eigenmann 1912:406 (type locality: Rockstone, British Guiana), seen; Géry 1977:309, 314.

Types. Holotype: FMNH 53669 (formerly CM 2142), examined. Paratypes: FMNH 53670 (CM 2143a), FMNH 53671 (CM 2144a), CAS 61482(1) all examined.

Etymology. HETERO = different, CHARAX = a genus of characid; MACRO = large, LEPIS = scales.

Description

Illustrations. Fig. 153; Géry 1977:309, 314.

Range. It is found in Guyana, in the Río Negro drainage and the Middle Amazon basin, and in the Orinoco Basin.

Diagnosis. This fish is distinguished by the following combination of characters: the anal-fin origin is under the dorsal-fin origin; the maxilla is well toothed, with conical teeth; the premaxilla has a single row of

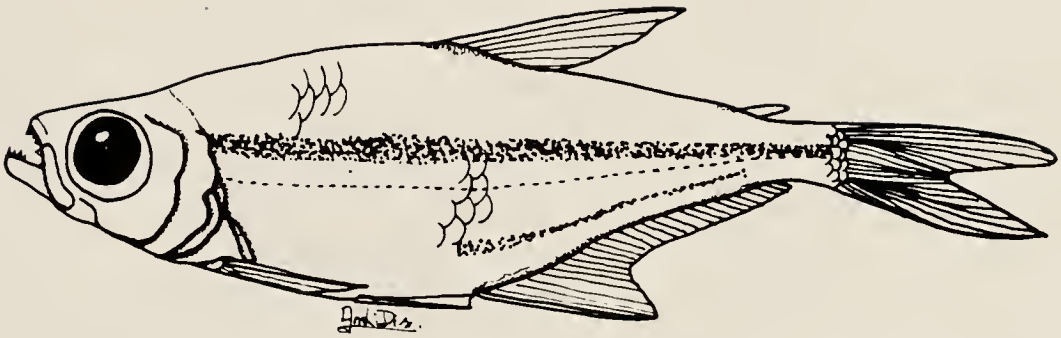


Figure 163. Heterocharax macrolepis.

conical teeth, some of them canines, the dentary has two rows of conical teeth (the second consists of very small teeth). The color pattern is also distinctive (fig. 153). Géry (1977) further characterized them as follows: preopercular angle without a real spine; opercle not spinous; clavicle notched; predorsal line scaled; lateral line complete; first pectoral ray soft; a single series of teeth on upper jaw.

Size. It can reach 50 mm SL, but most individuals are smaller.

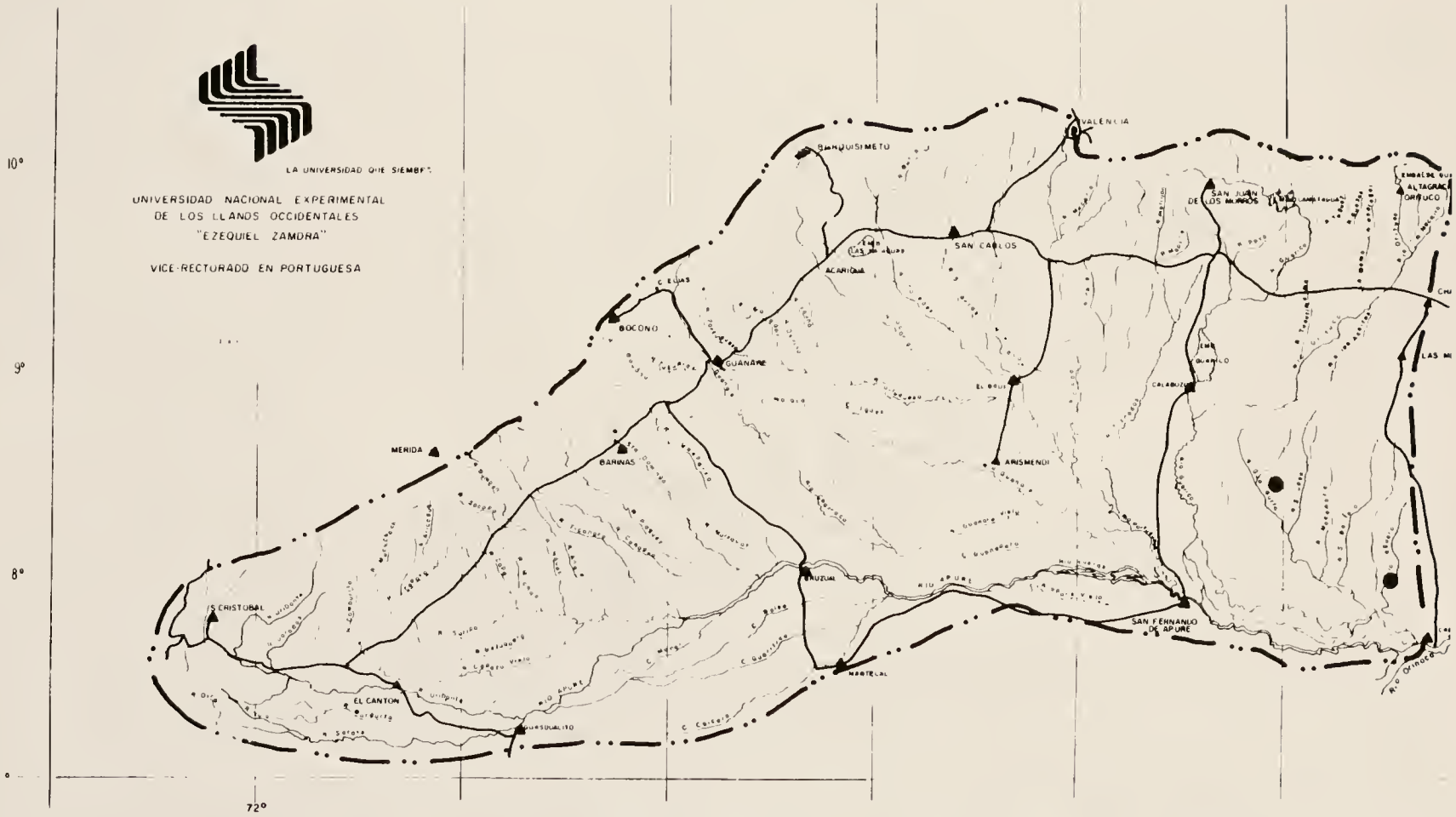
Morphology. In Apure drainage specimens the maxilla always reaches the end of the first suborbital bone. This character may vary, however, as in at least one paratype the maxilla did not reach the first suborbital. The snout tip to end of maxilla distance reaches to behind the center of the eye. The scales on the dorsum are much smaller than those below the lateral line. In one paratype, there are lateral extensions of the main lateral line canal. The dorsal-fin origin is almost equidistant between the snout tip and the caudal-fin base. The pectoral fins reach the pelvics, but the pelvics do not quite reach the anal fin. The preopercle is without a really sharp spine. The eye is quite large, much longer than snout. The jaws all possess some canine teeth.

Counts. DR ii9; AR 37;PR i12; VR i7; LS 35; TS 13; GR 6 + 4-5 rudiments on the lower arch. The premaxilla has about 10 conical teeth plus 3-4 enlarged canines; the maxilla is completely toothed with over 30 conical teeth, the dentary has 2-3 large canines and numerous smaller conical teeth.

Measurements. PDL about 49% SL; HL about 27% SL; SNT about 22% HL, much shorter than eye diameter which is about 48% HL; GBD about 36% SL.

Pigmentation. A wide, distinct lateral stripe is present from opercle to tail. The dorsal midline is marked with a dark line, as is the anterior anal-fin base. Another dark line begins on the sides above the anal-fin

Figure 154. Apure drainage distribution of *Heterocharax macrolepis*.



CUENCA DEL RIO APURE

origin and runs back to the caudal peduncle. All fins are clear except the caudal, which is dusky gray.

Distribution and Natural History

Apure distribution. Map: fig. 154. It has been found only in the Aguaro River system in the southeastern corner of the Apure drainage.

Habitat. It is restricted to blackwater streams and morichales.

Abundance. RARE.

Number of specimens examined. 5 from 2 collections.

Food. CARNIVORE. It probably feeds on aquatic insects, microcrustaceans and small fishes.

Reproduction. Probable strategy: rl. It may spawn throughout the rainy season.

Importance. It is potentially valuable as an aquarium fish.

Hyphessobrycon bentosi Durbin 1908

Sardinita - Flag Tetra

Fig. 155. Map: fig. 156. Couplet 56a.

Generic synonymy

Hyphessobrycon Durbin 1908:100 (type species: Hemigrammus compressus Meek 1904, by original designation).

Specific synonymy

Hyphessobrycon bentosi Durbin in Eigenmann 1908:101 (type locality: Obidos, Brazil [Middle Amazon basin]), seen; Eigenmann 1910:436; 1918:183 (key); Géry 1977:479, 483, 500 (key).

Types. Holotype: CAS 42682. Paratypes: MCZ 20842(21).

Comments. The taxonomic distinction between Megalamphodus sweglesi Géry 1961 and Hyphessobrycon bentosi Durbin 1908 is "nebulous," as indicated by Géry (1977). The premaxillary row of teeth could be interpreted as

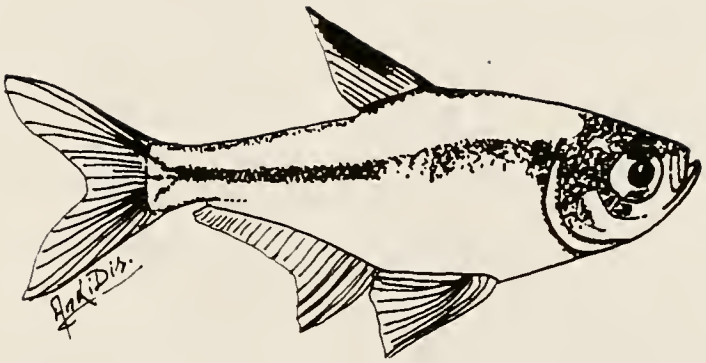


Figure 155. Hyphessobrycon bentosi.

"single" if you accept a few (1-2, usually) as out of line (perhaps in the process of being replaced), but in some fish it seems that there are two definite rows. Since this problem cannot be resolved here, I have opted to use Hyphessobrycon bentosi which is the older name and thus the one having priority should these two forms prove to be identical.

Etymology. HYPHESSO = smaller, from the Greek, BRYCON = "gnasher of teeth" in Greek, and also a genus of characid; BENTOSI = after Sr. Bentos, the collector of the type series.

Description

Illustrations. Fig. 155 (a large adult is depicted in the figure, most specimens are not so robust); Eigenmann 1918:pls. 25, 79; Géry 1977:483.

Diagnosis. The large black mark in the dorsal fin, and large distinct humeral spot are characteristic of this species. The premaxilla has two rows of teeth. The anal fin has 26-27 rays.

Size. It grows to about 30 mm SL.

Morphology. The lateral line is incomplete.

Counts. DR 11; AR iii23-iii27; LS 25; TS 5-6/3-4; 7-9 teeth in inner row of premaxilla; GR 14.

Measurements. HL 3.3-3.5 in SL; GBD 2.8-3.2 in SL.

Pigmentation. The holotype has lost the humeral spot if one was present. In Apure drainage specimens, the dorsal fin has a distinct black spot and a dark humeral spot is present, but there is no caudal spot.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 156. It is known only from the low llanos.

Figure 156. Apure drainage distribution of *Hyphessobrycon bentosi*.

CUENCA DEL RIO APURE

Habitat. H. bentosi occurs in quiet blackwater llaneran streams and is usually associated with fine-leaved aquatic vegetation.

Abundance. UNCOMMON.

Number of specimens examined. 112 from 21 collections.

Food. OMNIVORE. It eats insects, microcrustaceans, and seeds.

Reproduction. Strategy: rl. It spawns throughout the wet season.

Importance. Ornamental.

Hyphessobrycon metae Eigenmann & Henn 1914

Sardinita del Meta - Meta Tetra

Figs. 50 & 157. Map: fig. 158. Couplet 69a.

Specific synonymy

Hyphessobrycon metae Eigenmann & Henn 1914:233 (type locality: Río Meta at Barrigona, Colombia), seen; Eigenmann 1918:203 (key); Géry 1977:469, 471, 472 (key).

Types. Holotype: CAS 61751 (IU 13421); Paratypes: CAS 61752(2) (IU 13422).

Etymology. METAE = from the Río Meta.

Description

Illustrations. Figs. 50 & 158; Eigenmann 1918:pl. 93; Géry 1977: 469.

Diagnosis. The wide dusky lateral band and overall darkly pigmented body are characteristic of this species. There are no marks in the dorsal or anal fins. The lateral line is short, with only 6-7 pored scales.

Size. It reaches about 40 mm SL.

Morphology. The lateral line is incomplete with about six pored scales extending to middle of the depressed pectoral fins. The maxilla does not reach back to the level of pupil. There is a row of scales along the base of the anal fin; the caudal-fin base is also well scaled.

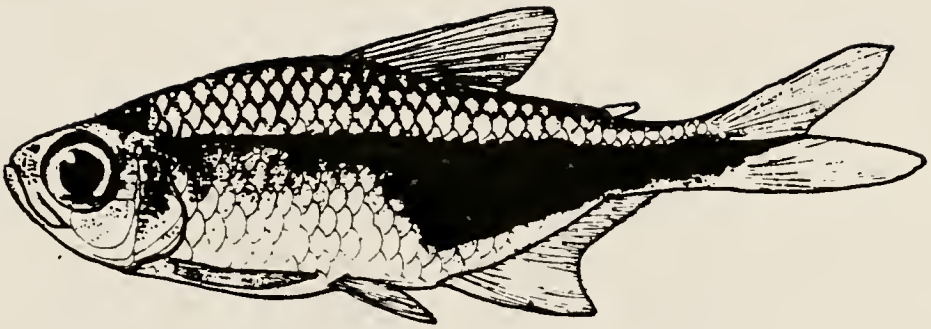
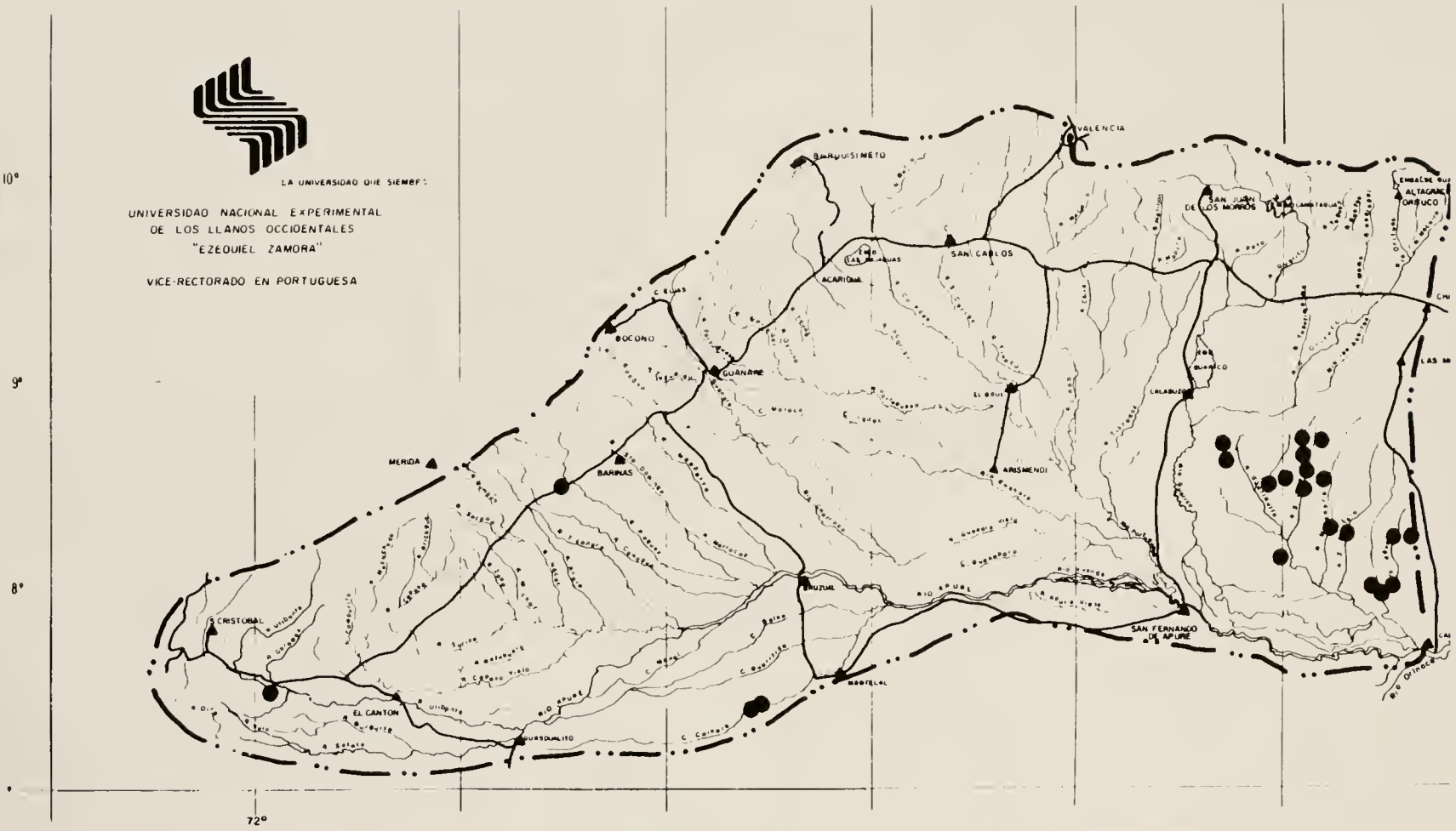


Figure 157. Hyphessobrycon metae. From Eigenmann (1918).

Figure 158. Apure drainage distribution of *Hyphessobrycon metae*.



CUENCA DEL RIO APURE

Counts. DR i10; AR iii18-iii20, hooks on first 6 rays; PR i9; VR i7; LS 28-32 PDS 10 TS 9; premaxilla with 2 teeth in outer row, 6 in inner, 1-2 teeth on maxilla.

Measurements. HL 3.5-4 in SL.

Pigmentation. The head, body and fins are all heavily pigmented with melanophores. The pigment in the caudal fin is concentrated along the central rays. A pale unpigmented area is present just above the posterior margin of the anal-fin base. The dorsal, adipose, upper and lower caudal-fin lobes have red patches in some populations (perhaps varying with season). The holotype has a triangular spot on the central caudal-fin rays.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 158. It is most common in northern Apure state and the Aguaro River system.

Habitat. It is found in blackwater streams and morichales.

Abundance. COMMON.

Number of specimens examined. 348 from 28 collections.

Food. OMNIVORE. Microcrustaceans, seeds, and insects comprise its diet.

Reproduction. Strategy: r1. It probably spawns throughout the rainy season.

Importance. Ornamental.

Iguanodectes spilurus (Günther) 1864

Sardinita - Spindle Tetra

Fig. 42 (maxilla) & 159. Map: fig. 160. Couplet 48a.

Generic synonymy

Iguanodectes Cope 1872:260 (type species: Iguanodectes tenuis Cope).

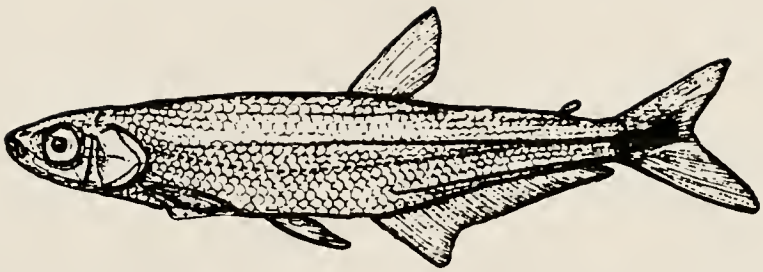


Figure 159. Iguanodectes spilurus.

Specific synonymy

Piabucus spilurus Günther 1864:344 (type locality: Cupai River); Eigenmann & Eigenmann 1891:57; Steindachner 1891:23; Eigenmann 1910:440.

Iguanodectes spilurus Mago L. 1970:71; Géry 1970c:417; 1977:368, 368, 374.

Etymology. IGUANO = from "Iguana, native Haytian name of a lizard" (Cope 1871), DECTES = a receiver (allusion obscure); SPIL = spot, URUS = tail.

Description

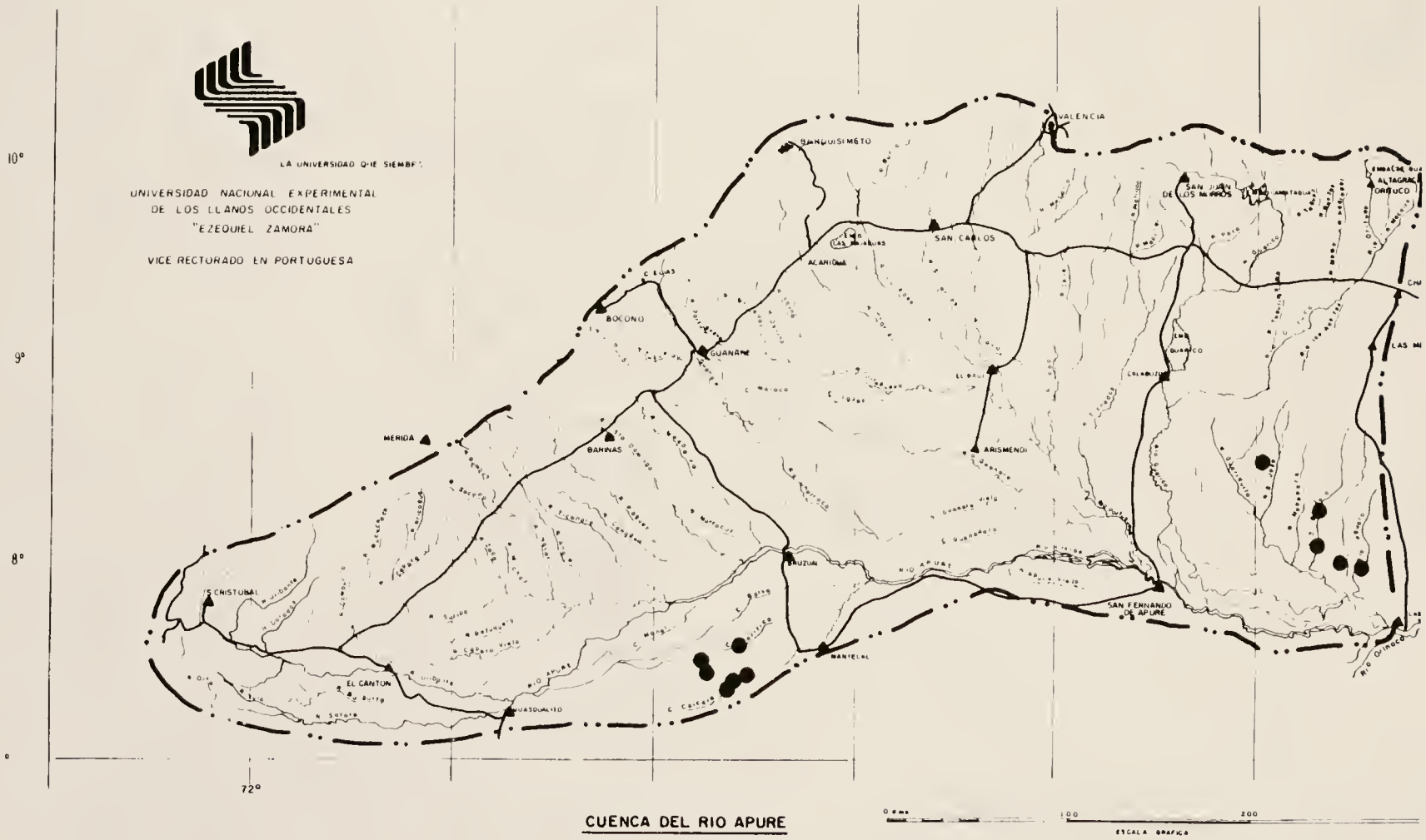
Illustrations. Fig. 42 (maxilla length) & 159; Géry 1970:figs. 2, 5; 1977:368, 369.

Diagnosis. The teeth of this species are slightly asymmetrical, greatly expanded (widened) at the tip, and multicuspid. The premaxilla has an inner row of five teeth, but the outer has only one or two. The body is long and slender, with a high lateral-line scale count (54-64).

Size. It can grow to about 90 mm SL, but most individuals are between 40-60 mm.

Morphology. This is an elongate, spindle shaped fish with a very small mouth that is entirely in front of the eye. The dorsal fin is posterior in position, with its origin behind the midpoint of the SL, but anterior to the origin of the anal fin. The gill membranes are united, but free from isthmus. The breast and preventral area are rounded. The lateral line is complete. The eye is longer than the snout. Vari (1977) described the unique anatomy of the three chambered swim bladder in this species and presented characters in support of the monophyly of the subfamily Iguanodectinae.

Figure 160. Apure drainage distribution of *Iguanodectes spilurus*.



CUENCA DEL RIO APURE

Counts. DR ii8-ii9; AR iii31-iii36; PR i12-i13; VR i7; LLS 54-64; TS 6-8 above LL, 4-5 below. The premaxilla has 5-6 multicuspid teeth that are constricted at their bases and expanded at the tips, maxilla with 1-2 teeth, dentary with 7-8.

Measurements. HL 4.3-4.7 in SL; GBD 4.5-5.0 in SL.

Pigmentation. The tail is marked with a large black blotch. There is a thin black line along the posterior lateral midline and another above the base of the anal fin.

Distribution and Natural History

Range. It occurs in the Amazon Basin in Brazil and Peru, in Guyana, and in the Orinoco Basin.

Apure distribution. Map: fig. 160. This species is known from northern Apure state and the Aguaro River system.

Habitat. It frequents blackwater streams, and is usually seen in the current.

Abundance. UNCOMMON.

Number of specimens examined. 307 from 20 collections.

Food. OMNIVORE.

Reproduction. Strategy: r1. It probably spawns throughout the rainy season. Males develop hooks and lappets (a hook-like structure with the free end directed proximally, toward the body of the fish) on the anterior anal rays during the reproductive season.

Importance. Ornamental.

Markiana geayi (Pellegrin) 1908

Percha - Red-Bellied Tetra

Fig. 161. Map: fig. 162. Couplet 39a.

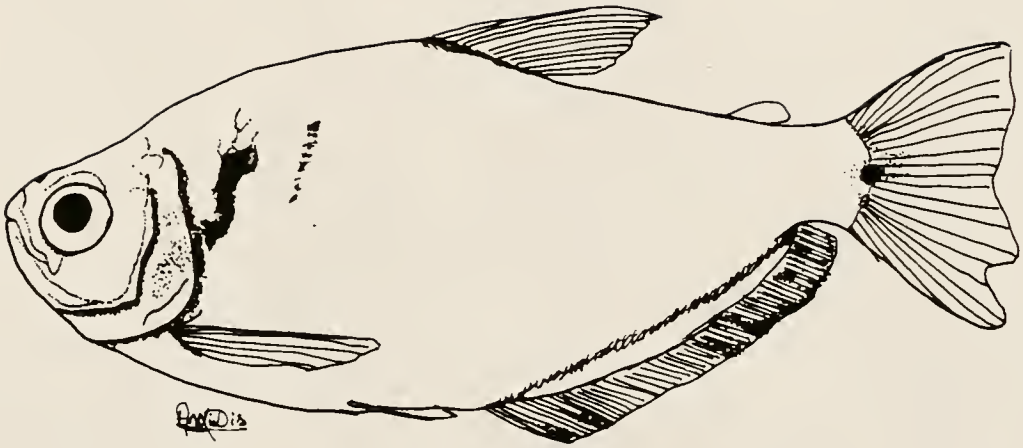


Figure 161. Markiana geayi.

Generic synonymy

Markiana Eigenmann 1903:145 (type species: Tetragonopterus nigripinnis Perugia 1891:643, by original designation).

Specific synonymy

Tetragonopterus (Markiana) geayi Pellegrin 1908:347 (type locality: Apure, Venezuela), seen.

Markiana geayi Eigenmann 1910:438; 1918:124.

Markiana nigripinnis Mago L. 1970:71; Román 1985:178 (Venez.).

Comments. Although Pellegrin (1908) commented that M. geayi lacked the caudal spot present in M. nigripinnis from the La Plata Basin, his description was based on only one specimen. Some Apure specimens lack caudal pigment, but most have a large black spot on the caudal base; I suspect that Pellegrin's specimen had simply lost its color. This then raises the question of synonymy since the two agree fairly closely in the few counts and measurements given by Pellegrin. Since I cannot make a direct comparison, I have chosen to maintain the name M. geayi since it is based on specimens from the Apure drainage. In most cases, similar species from northern and southern South America have ultimately proven to be different, a factor related largely to the large geographic distances involved. Even so, unless these two forms differ in characters other than those used so far to distinguish them, the southern and northern forms would appear to be synonyms.

Etymology. MARKIANA = was named after a teacher of C. Eigenmann, Dr. Edward Laurens Mark, who for more than 25 years was head of the Harvard University Zoology Department, where Eigenmann was a student; GEAYI = is named after F. Geay, a contemporary of Pellegrin who reported on the fisheries of the Orinoco Basin in his work "Pêches dans les Affluentes de l'Orinoque" (Schultz 1944b).

Description

Illustrations. Fig. 161; Román 1985:178.

Diagnosis. The crenate scales that gradually become smaller in the rows below the lateral line, the dark horizontal wavy lines on the sides, the red breast (in life), and scaled anal and caudal fins are characteristic of this species.

Size. It grows to about 90 mm SL.

Morphology. The lateral line is complete, the anal fin and caudal fin are scaled, the gill rakers are setiform, and the dorsal-fin origin is posterior to the pelvic-fin origin.

Counts. DR ii9-ii10; AR iii37-iii40; PR i11-i12; VR i7; LLS 41; TS 8-9 above LL, 7-8 below.

Pigmentation. The body is silvery with wavy lines of melanophores between the scale rows on the sides. The pectoral, pelvic and anal fins as well as the breast are red. The humeral spot is diffuse. A black caudal spot is present, but not obvious in all preserved specimens.

Distribution and Natural History

Range. It occurs in Orinoco Basin.

Apure distribution. Map: fig. 162. It occurs throughout the llanos.

Habitat. It inhabits lentic and lotic systems in the llanos.

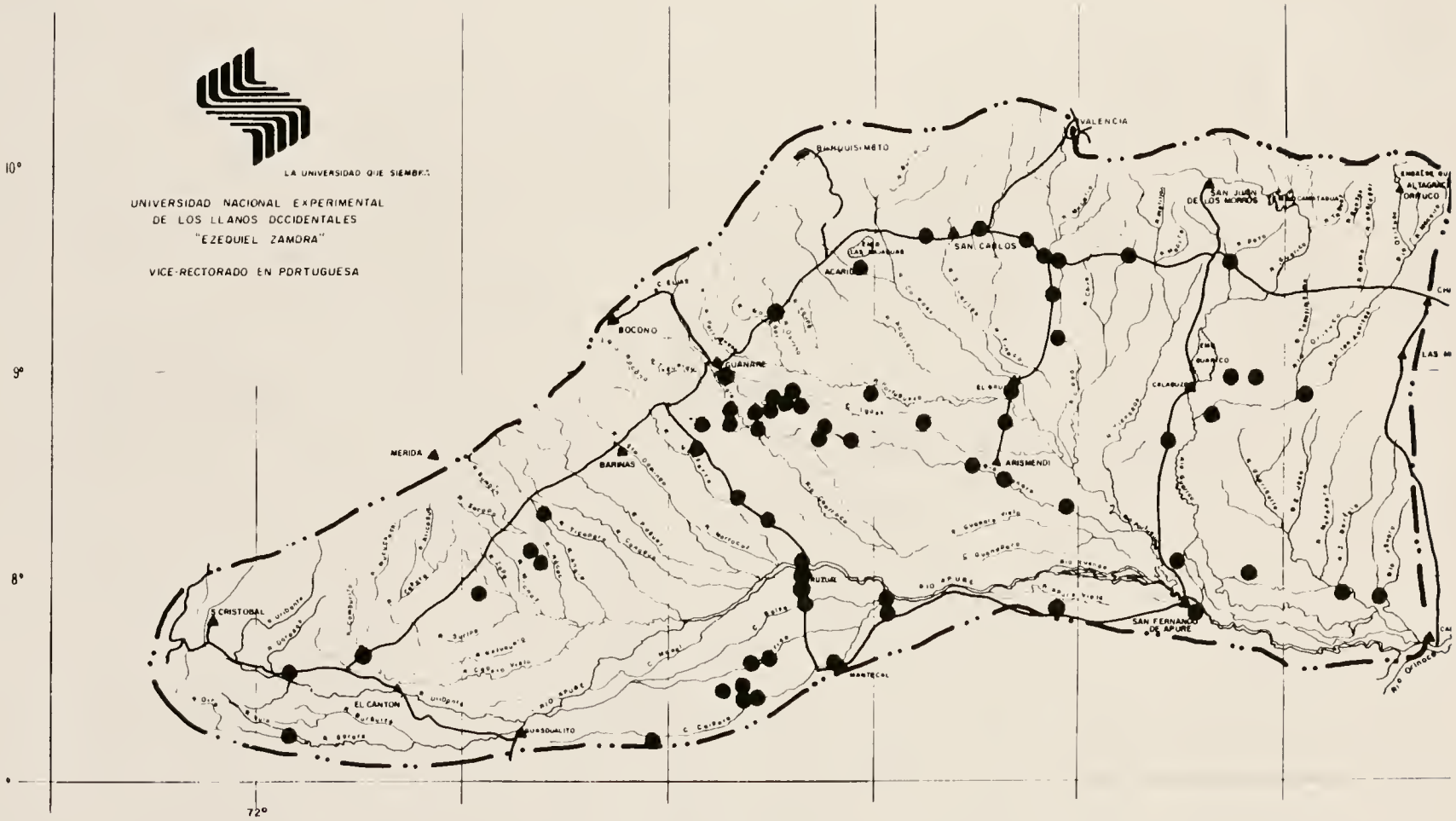
Abundance. COMMON.

Number of specimens examined. 878 from 124 collections.

Food. OMNIVORE. Its diet includes seeds, terrestrial insects, and aquatic vegetation.

Reproduction. Strategy: r2; fecundity: 3398 eggs/ovary; egg diameter: 1 mm. This species spawns once a year, during the first months of the rainy season. There is no parental care. (Winemiller & Taphorn 1989).

Figure 162. Apure drainage distribution of *Markiana geayi*.



CUENCA DEL RIO APURE

Importance. Ornamental.

Megalamphodus cf axelrodi (Travassos) 1959

Sardinita - Calypso Tetra, Red Pristella

Fig. 163. Map: fig. 164. Couplet 57a.

Generic synonymy

Megalamphodus Eigenmann 1915b:49 (type species: Megalamphodus megalopterus Eigenmann 1915b:150, by original designation).

Ectrepopterus Fowler 1943b:313 (type species: Megalamphodus uruguayensis Fowler 1943b:313, by original designation).

Specific synonymy

Aphyocharax axelrodi Travassos in Axelrod 1959:3 (type locality: Trinidad), not seen.

Megalamphodus axelrodi Axelrod et al. 1971:F-48.00; Géry 1977:572, 586.

Etymology. MEGALAMPHODUS is from Greek meaning "with spacious ways" (Eigenmann 1919); AXELRODI = after Dr. Herbert Axelrod.

Description

Illustrations. Fig. 163; Géry 1977:572; Axelrod et al. 1971:F-48.00.

Diagnosis. In life the body is mostly red posteriorly and the dorsal fin has a black blotch on the upper margin of the anterior rays. The teeth are all conical including three small teeth often present on the maxilla. There are 24-26 anal-fin rays.

Size. This dwarf species grows to about 25 mm TL, but most individuals are smaller.

Pigmentation. The body is mostly transparent but the rear portion and the tail are bright red or pink and the belly is silvery. The dorsal fin has a black blotch. Females are not as colorful as males.

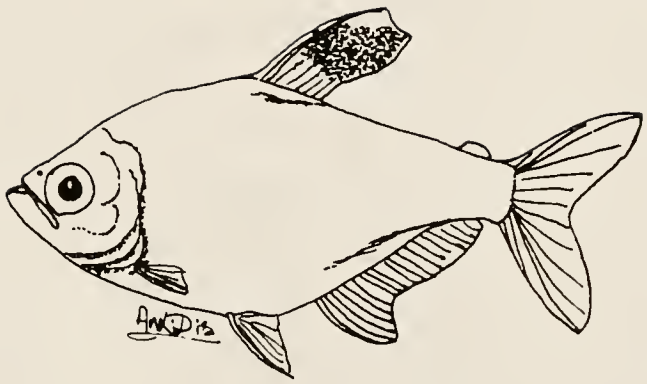
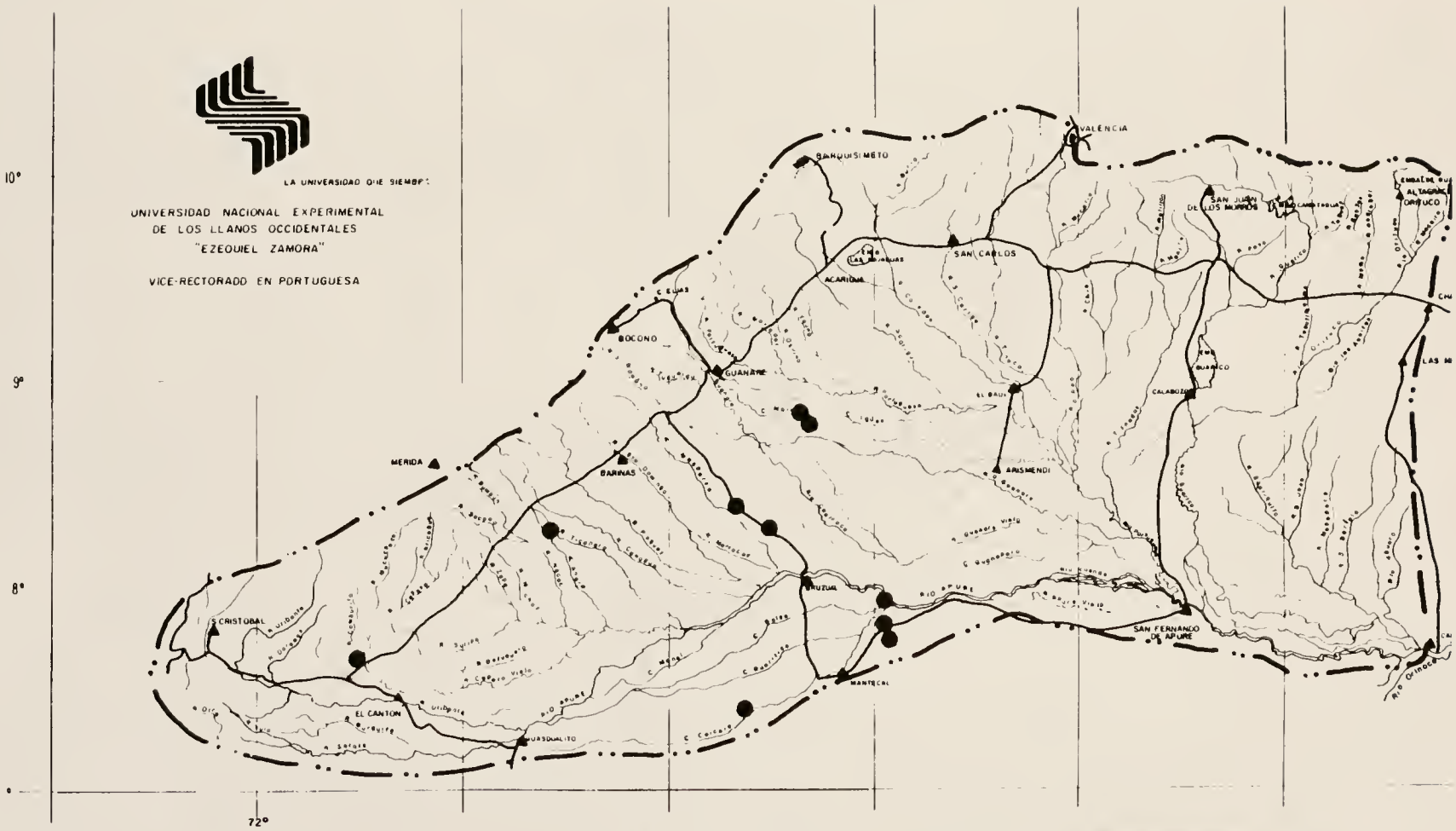


Figure 163. Megalamphodus cf axelrodi.

Figure 164. Apure drainage distribution of *Megalamphodus* cf *axelrodi*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in Trinidad and in northern South America.

Apure distribution. Map: fig. 164. It has a spotty distribution in the Apure drainage.

Habitat. *Megalamphodus* cf *axelrodi* is usually found amidst aquatic vegetation, in quiet sidewaters of slow-moving llanos streams.

Abundance. UNCOMMON.

Number of specimens examined. 83 from 17 collections.

Food. OMNIVORE. It eats microcrustaceans, tiny seeds, and small insects.

Reproduction. Strategy: r1. It probably spawns throughout the rainy season. In aquaria, adhesive eggs are scattered over aquatic vegetation and then abandoned.

Importance. Ornamental.

Metynnis argenteus Ahl 1923

Palometa Plateada - Silver Dollar

Fig. 165. Map fig. 166. Couplet 17a.

Generic synonymy

Metynnis Cope 1878:692 (type species: *Metynnis luna* Cope 1878, by monotypy).

Myleocollops Eigenmann 1903:147 (type species: *Metynnis goeldii* Eigenmann 1903, by original designation).

Sealeina Fowler 1906:478 (type species *Myletes lippincottianus* Cope 1870, by original designation).

Specific synonymy

Metynnis argenteus Ahl 1923:24 (type locality: Río Tapajós [tributary of the lower R. Amazonas]), seen; Mago L. 1970:71; Géry 1977:270, 271 (key).

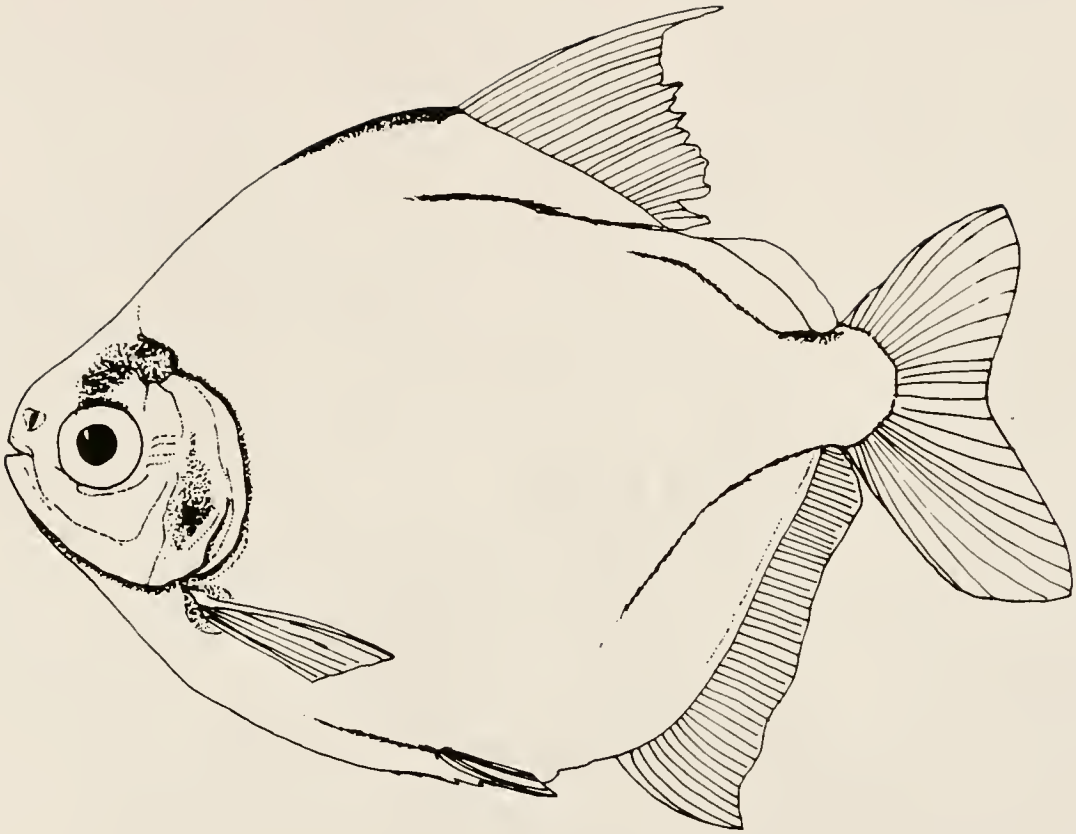


Figure 165. Metynnis argenteus.

Comments. The genus Metynnis, as is true of most characid genera, is in need of revision. There are several names available for the Venezuelan species, but most were described from geographic localities far from Venezuela.

Etymology. METYNNIS = with a plow, referring to the keeled belly; ARGENTEUS = silvery.

Description

Illustrations. Fig. 165; Géry 1977:280.

Diagnosis. This species is distinguished from other species of the genus by the following combination of characters: gill rakers on the lower limb of first arch 17-23; supraoccipital process relatively short, and measuring more than 2.6 times in the distance from the base of the occiput to the dorsal-fin origin; adipose fin not extremely long and short, the distance from the rear margin of the dorsal-fin base to the adipose fin measuring 1.5 times in the length of the adipose-fin base. They also might be confused with small Mylossoma or Myleus, but members of those genera have a much shorter adipose-fin base (the adipose-fin base length is less than the distance from the posterior edge of the dorsal-fin base to the origin of the adipose fin (fig. 33).

Size. It grows to about 150 mm SL.

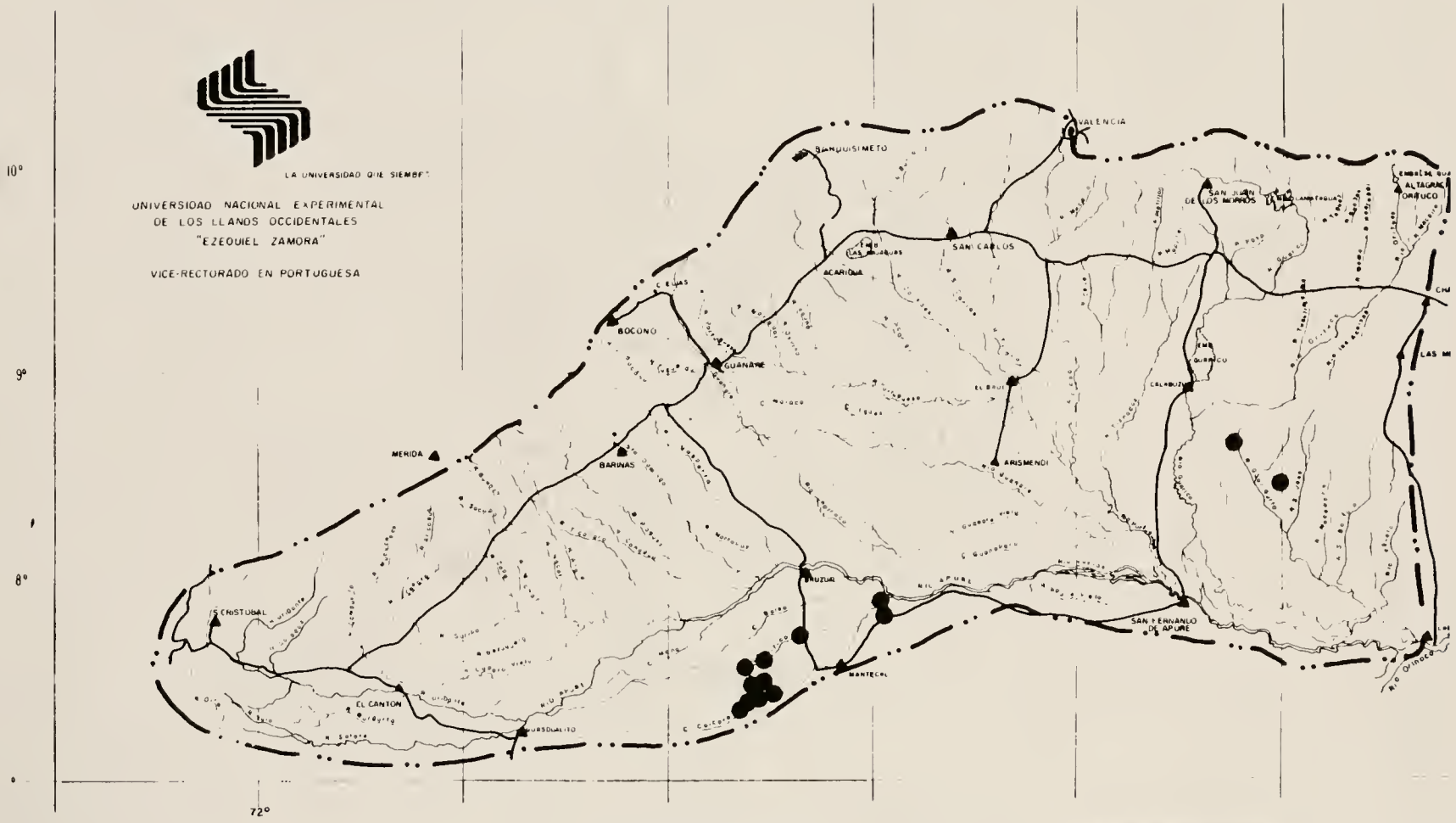
Morphology. The body is discoid.

Counts. DR ii16-18; AR 34; abdominal scutes 34.

Measurements. GBD 80-88 % of SL (N=8).

Pigmentation. The body is silvery, with a purple to orange sheen. The dorsal fin usually has several irregular black spots. The caudal and anal fins are faint orange to pink.

Figure 166. Apure drainage distribution of *Metynnis argenteus*.



CUENCA DEL RIO APURE

0 100 200
ESCALA GRAFICA

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig 166. This species is known from a few localities in northern Apure state, and the upper Aguaro River system.

Habitat. It is found both in running and quiet waters, usually associated with aquatic vegetation.

Abundance. UNCOMMON. The relative scarcity of this species may be more a reflection of difficulties in collecting, rather than true rarity.

Number of specimens examined. 178 from 24 collections.

Food. OMNIVORE. It is mostly vegetarian, consuming seeds, flowers, fruits, aquatic plants.

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June. A pair that spawned in aquaria released eggs early in the day, before dawn. The pair scattered the eggs at random after violent side-by-side quivering. It probably spawns over aquatic vegetation in nature.

Migrations. These fish live much longer than a year, and so probably make biannual migrations to stay in favorable habitat with the alternation of the wet and dry seasons.

Importance. It is a highly prized ornamental species.

Metynnis hypsauchen (Müller & Troschel) 1844

Palometa - Silver Dollar

Fig. 167. Map: fig. 168. Couplet 17b.

Specific synonymy

Myletes hypsauchen: Müller & Troschel 1844:97 (type locality: British Guiana), seen.

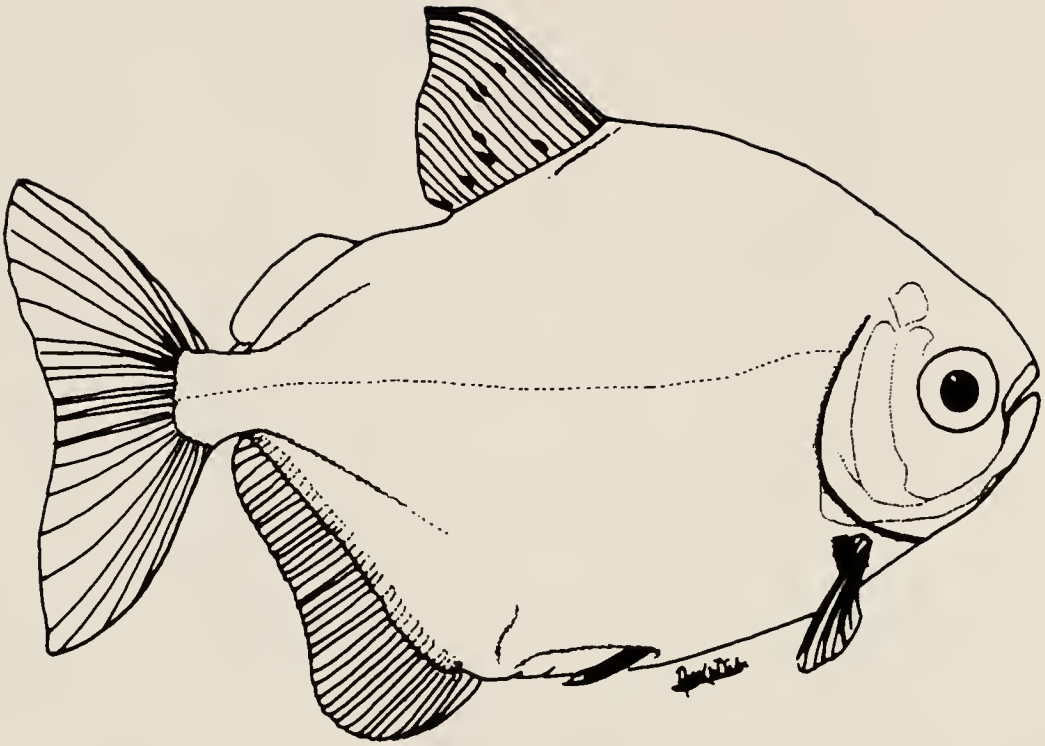


Figure 167. Metynnis hypsauchen.

Metynnis hypsauchen Eigenmann & Ogle 1907:35 (South America); Ahl 1923:21 (key); Fowler 1948:394 (synonymy).

Metynnis orinocensis Steindachner 1908b:359 (type locality: ?Río Orinoco).

Metynnis (Myleocollops) hypsauchen Géry 1972:190.

Comments. According to Géry (1977), M. orinocensis Steindachner 1908 is a synonym of this species, but this remains to be proved.

Etymology. HYPS = from the Greek "hypsos" for height, AUCHEN = from Greek for nape, referring to the deep body.

Description

Illustrations. Fig. 167; Géry 1972:191 fig. 27 (drawing of holotype); 1977:277 (photo).

Diagnosis. This species is distinguished from other members of the genus by the following combination of characters: gill rakers on lower limb of first arch about 35; supraoccipital process very long, and measuring less than 2.4 times in the distance from the base of the occiput to the dorsal-fin origin; the adipose fin is extremely long and low, the distance from the rear margin of the dorsal-fin base to the adipose fin measuring more than 1.5 times in the length of the adipose-fin base. See diagnosis of M. argenteus to distinguish this species from those of other similar genera.

Size. It reaches about 150 mm SL.

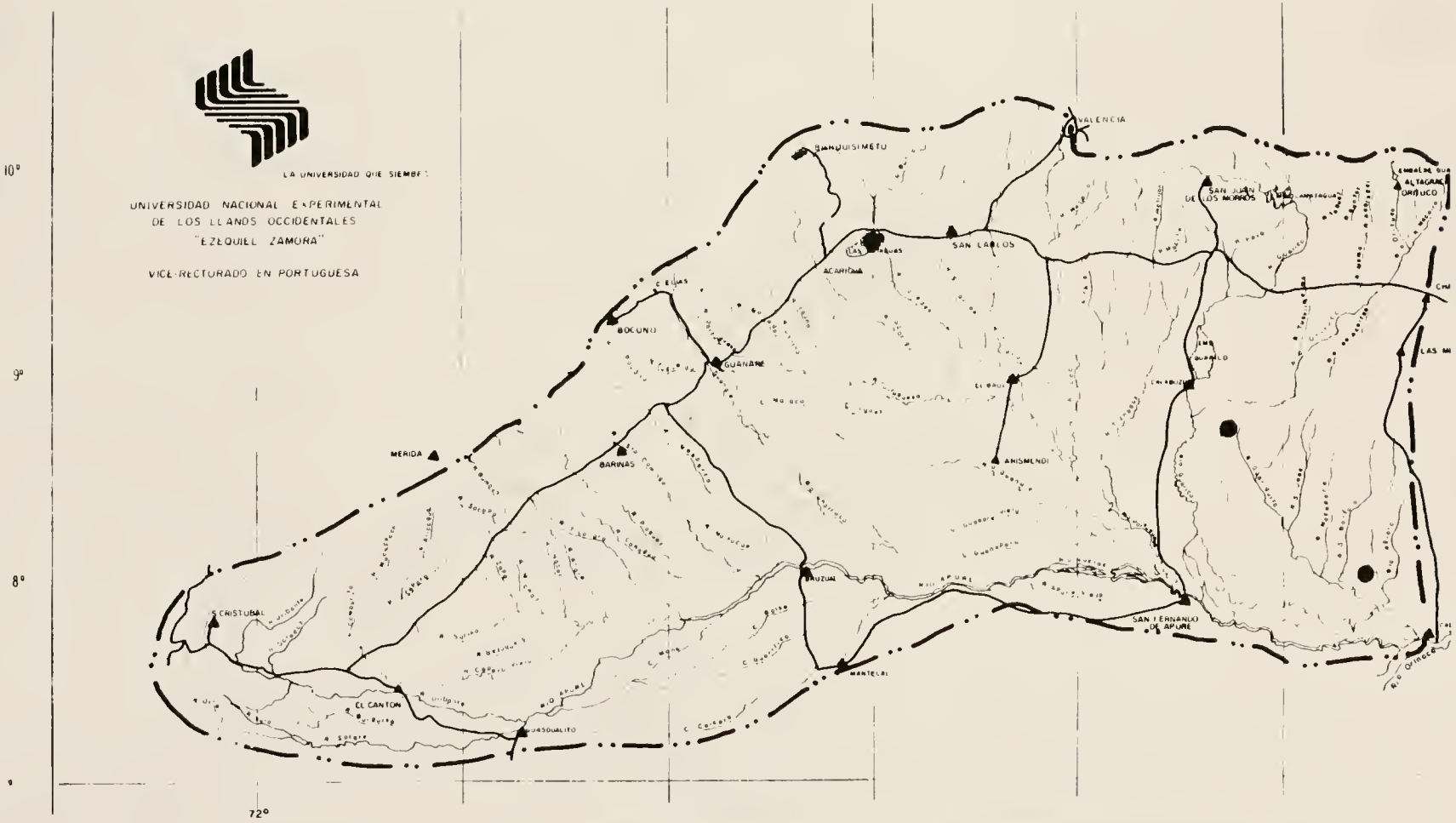
Morphology. The body is discoid.

Counts. DR ii16-18; A 39-44; abdominal scutes 26-35.

Measurements. GBD 79% SL; HL 3.75 in SL.

Pigmentation. The body is silvery with a few dots present in the dorsal fin. During the breeding season adults take on an orange sheen.

Figure 168. Apure drainage distribution of *Metynnis hypsauchen*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It is found in the Amazon and Orinoco basins, and Guyana.

Apure distribution. Map: fig. 168. It is restricted to the Aguaro River system.

Habitat. It has been found in lentic and slower-moving sectors of lotic systems.

Abundance. RARE.

Number of specimens examined. 8 from 3 collections.

Food. OMNIVORE. It is mostly vegetarian, consuming seeds, fruits, flowers, aquatic plants.

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June.

Migrations. These fish live much longer than a year, and so probably make biannual migrations to stay in favorable habitat with the alternation of the wet and dry seasons.

Importance. Ornamental.

Metynnis luna Cope 1878

Palometa - Bleeding Heart Silver Dollar

Fig. 169. Map: fig. 170. Couplet 16a.

Specific synonymy

Metynnis luna Cope 1878: 692 (type locality: Peruvian Amazon), not seen; Ahl 1923:20 (key).

Comments. This is the type species of the genus. It is the only Metynnis with such a high number of gill rakers. The specific identification of this and other Metynnis species is difficult, and uncertain due to the plethora of synonyms in the literature, which are mostly based on incomplete original descriptions.

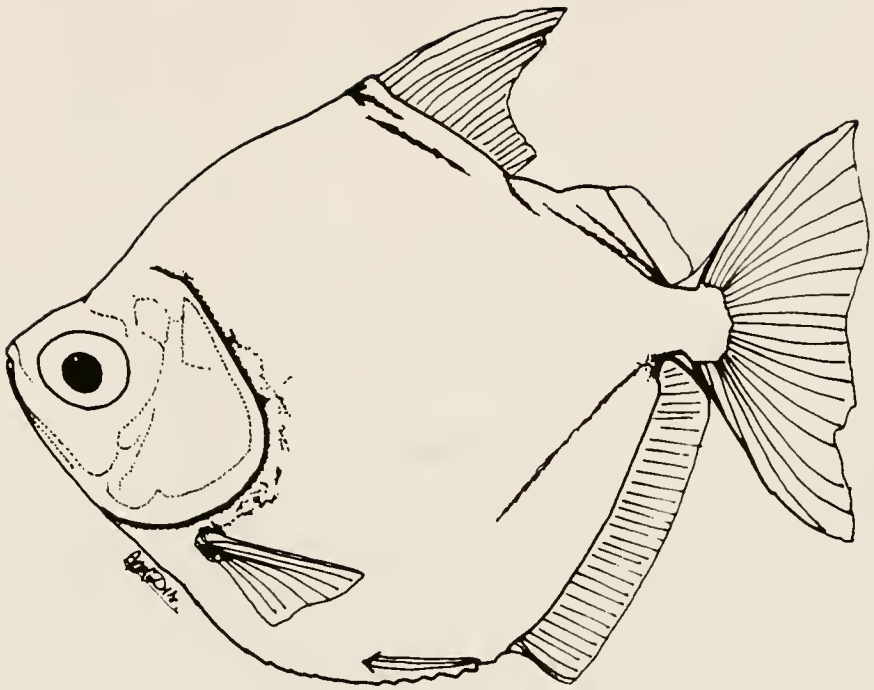


Figure 169. Metynnis luna.

Etymology. LUNA = moon shaped.

Description

Illustrations. Fig. 169; Fowler 1950:396 fig. 440; Géry 1977:276; Román 1985:117.

Diagnosis. This is the only *Metynnis* species with more than 50 total gill rakers on the outer arch. See diagnosis of *M. argenteus* for distinguishing characters of this species from those of other similar genera.

Size. It grows to about 150 mm SL.

Morphology. The discoid body comes to a "peak" with the apex at the dorsal-fin origin.

Counts. DR 18; AR 39; abdominal scutes 25.

Measurements. BD 80% SL; GBD 11/12 SL.

Pigmentation. This fish is silvery in life, with a red spot in the humeral area just behind the opercle.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 170.

Habitat. It has been found in lentic biotopes and slower-moving streams in the lower llanos, where it is usually associated with aquatic vegetation.

Abundance. UNCOMMON.

Number of specimens examined. 89 from 15 collections.

Food. OMNIVORE. It is mostly vegetarian, consuming seeds, fruit, flowers, and aquatic plants.

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June.

Figure 170. Apure drainage distribution of *Metynnis luna*.

CUENCA DEL RIO APURE

Migrations. These fish live much longer than a year, and so probably make biannual migrations to stay in favorable habitat with the alternation of the wet and dry seasons.

Importance. Ornamental.

Microschemobrycon casiquiare Böhlke 1953

Sardinita de Casiquiare - Casiquiare Tetra

Fig. 48 (caudal pattern) & 171. Map: 172. Couplet 67a.

Generic synonymy

Microschemobrycon Eigenmann 1915a:56 (type species: Microschemobrycon guaporensis Eigenmann 1915a, by original designation).

Specific synonymy

Microschemobrycon casiquiare Böhlke 1953b:841 (type locality: São Gabriel Rapids of the Río Negro, Brazil, shortly downriver from 0° 08' 03" South Latitude, 67° 03' 28" West Longitude, where the village of São Gabriel is situated), seen; Mago L. 1970:71; Géry 1977:590-1, 598 (key).

Types. Holotype: CAS 17497. Paratypes: CAS 17498(8); 17499(3); 17500(11); 17501(2); 17502(1); 17503(1); 17504(11); 17505(2); 17506(1); 17507(8); 17508(4); 17509(6); 17510(1); 17511(29); 17512(2); 20689(10); 20690(5).

Etymology. MICRO = small, SCHEMO = Greek for arrangement or plan, thus small of stature (Eigenmann 1919); BRYCON = a genus of characid; CASIQUIARE = after the Casiquiare Canal in Venezuela, where the fish was originally found.

Description

Illustrations. Fig. 48 (caudal pattern) & 171; Böhlke 1953d:pl. 20).

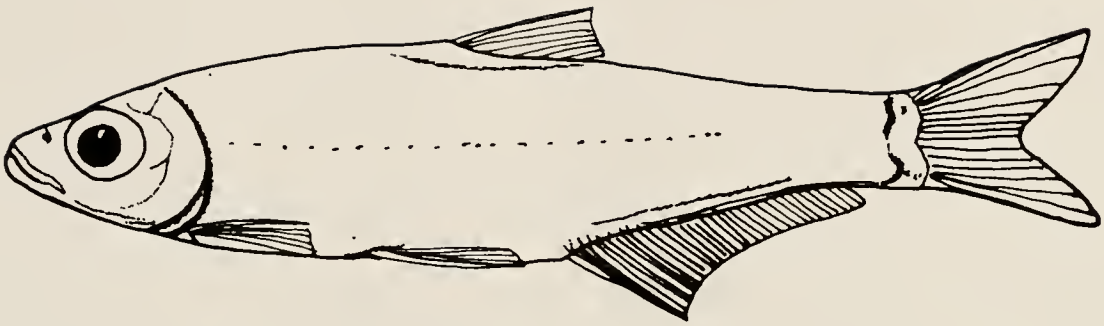


Figure 171. Microschemobrycon casiquiare.

Diagnosis. The humeral spot is absent. There is a dark crescent of embedded pigment at the base of each caudal-fin lobe (fig. 48). The premaxillary teeth are arranged in a single row.

Size. This is a small characid, rarely exceeding 40 mm SL.

Morphology. The body is elongate and slender, cigar-shaped, not greatly compressed. The dorsal-fin origin is about equidistant from the tip of the snout and the mid-caudal base. The lateral line is incomplete, with 18-23 pored scales.

Counts. DR ii8-ii9; AR iii15-iii18; PR i10i; VR i7; LS 26 (32-33 in type series); TS 4 above LL, 2 below. Premaxilla with 12-13 teeth in single row, maxilla with 5, dentary with 11 large tricuspid teeth followed by 7 smaller conical teeth; GR 9-11.

Measurements. HL 3.4-4.0 in SL, GBD 3.7-4.6 in SL.

Pigmentation. The body is tan and the fins are clear.

Distribution and Natural History

Range. It occurs in the Río Negro drainage (Amazon), the Casiquiare Canal, and the upper Orinoco Basin in Colombia and Venezuela.

Apure distribution. Map: 172. It is known only from the Aguaro River system.

Habitat. It is found in blackwater streams and morichales, usually near aquatic vegetation.

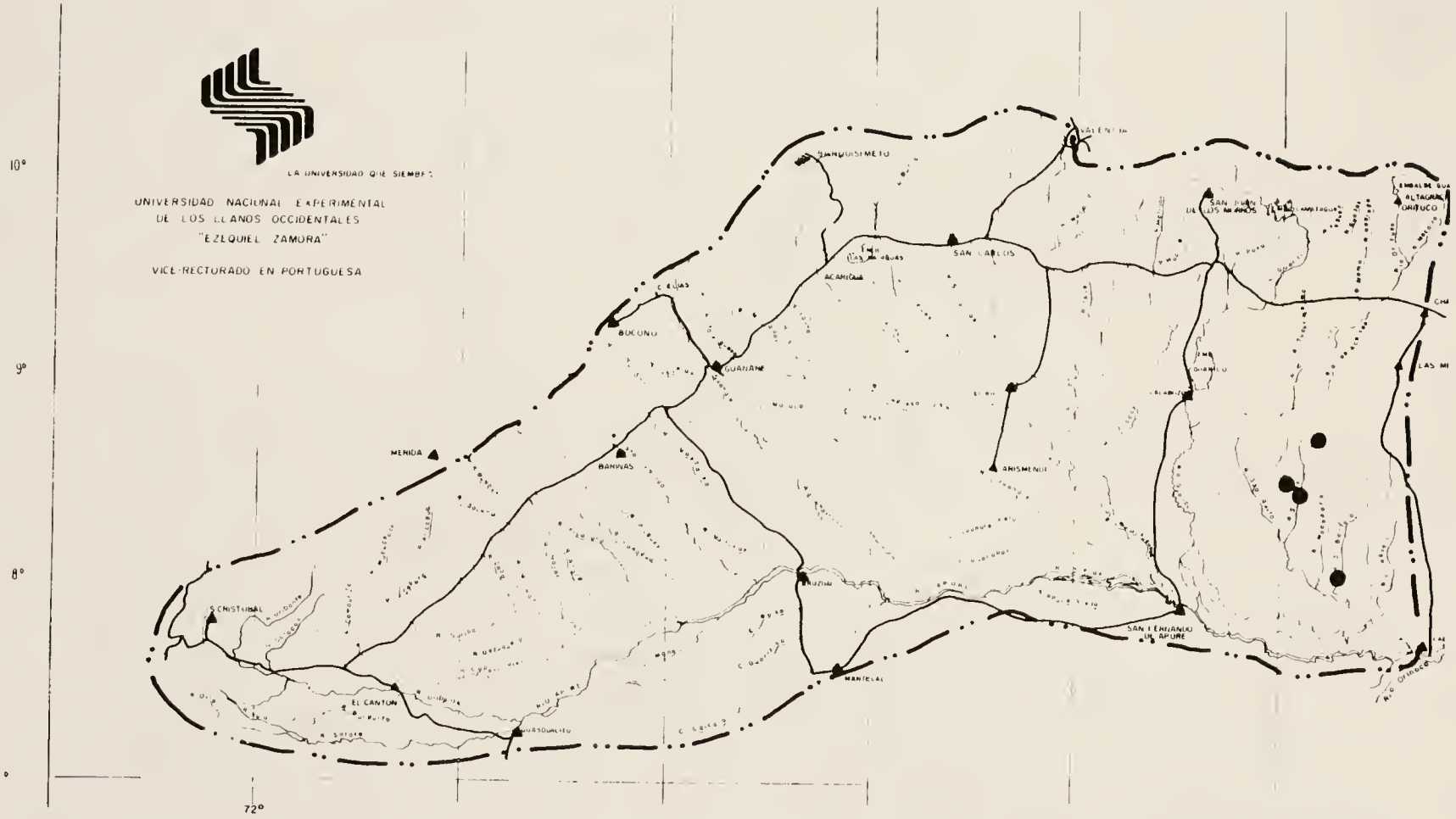
Abundance. UNCOMMON.

Number of specimens examined. 41 from 6 collections.

Food. MICROCARNIVORE. It probably feeds on microcrustaceans, and small insects.

Reproduction. Strategy: r1. It probably spawns throughout the rainy season.

Figure 172. Apure drainage distribution of *Microschemobrycon casiquiare*.



CUENCA DEL RIO APURE

Moenkhausia chrysargyrea (Günther) 1864

Palometica Aro de Oro - Golden-Circle Tetra

Fig. 173. Map: fig. 174. Couplet 94a.

Generic synonymy

Moenkhausia Eigenmann 1903:145 (type species: Tetragonopterus xinguensis Steindachner 1882:178, by original designation).

Specific synonymy

Tetragonopterus chrysargyrea Günther 1864:328 (type locality: Essequibo, British Guiana), seen.

Moenkhausia chrysargyrea Eigenmann 1910:437 (Brazil); 1912:323 (key, diagnosis, synonymy); 1917:75 (diagnosis).

Etymology. MOENKHAUSIA = to honor Professor W. J. Moenkhaus, of Indiana University (where Dr. Eigenmann worked for many years) and who for a time collaborated with the Museu Paulista, in São Paulo, Brazil; CHRYSAR = gold, from the Latin "chrysos," and GYREUS = circle, from the Latin "gyrus." The significance of this remains obscure. While there is no golden circle in preserved material, I suspect that the pale halo around the first humeral spot is probably golden in life.

Description

Illustrations. Fig. 173; Eigenmann 1917:pl. 6, fig. 2.

Diagnosis. The first humeral spot in this species is dark black, round in shape, and surrounded by a pale area. The second humeral spot, if present, is faint and vertically elongated. The caudal fin lacks black markings of any kind. The body is very deep, with its maximum depth about 2.0-2.1 in the SL.

Size. Although reported to reach 100 mm, most individuals are between 30-50 mm SL.

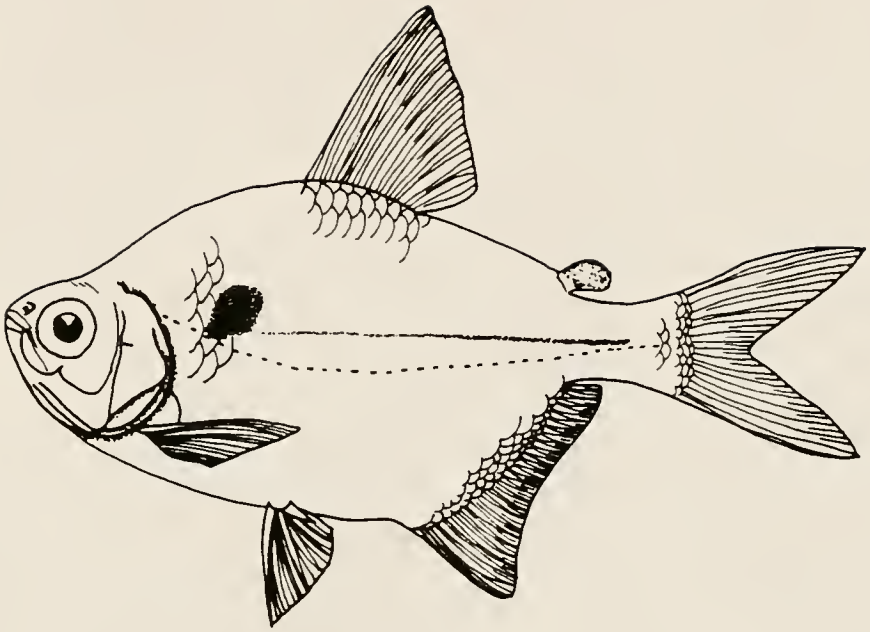
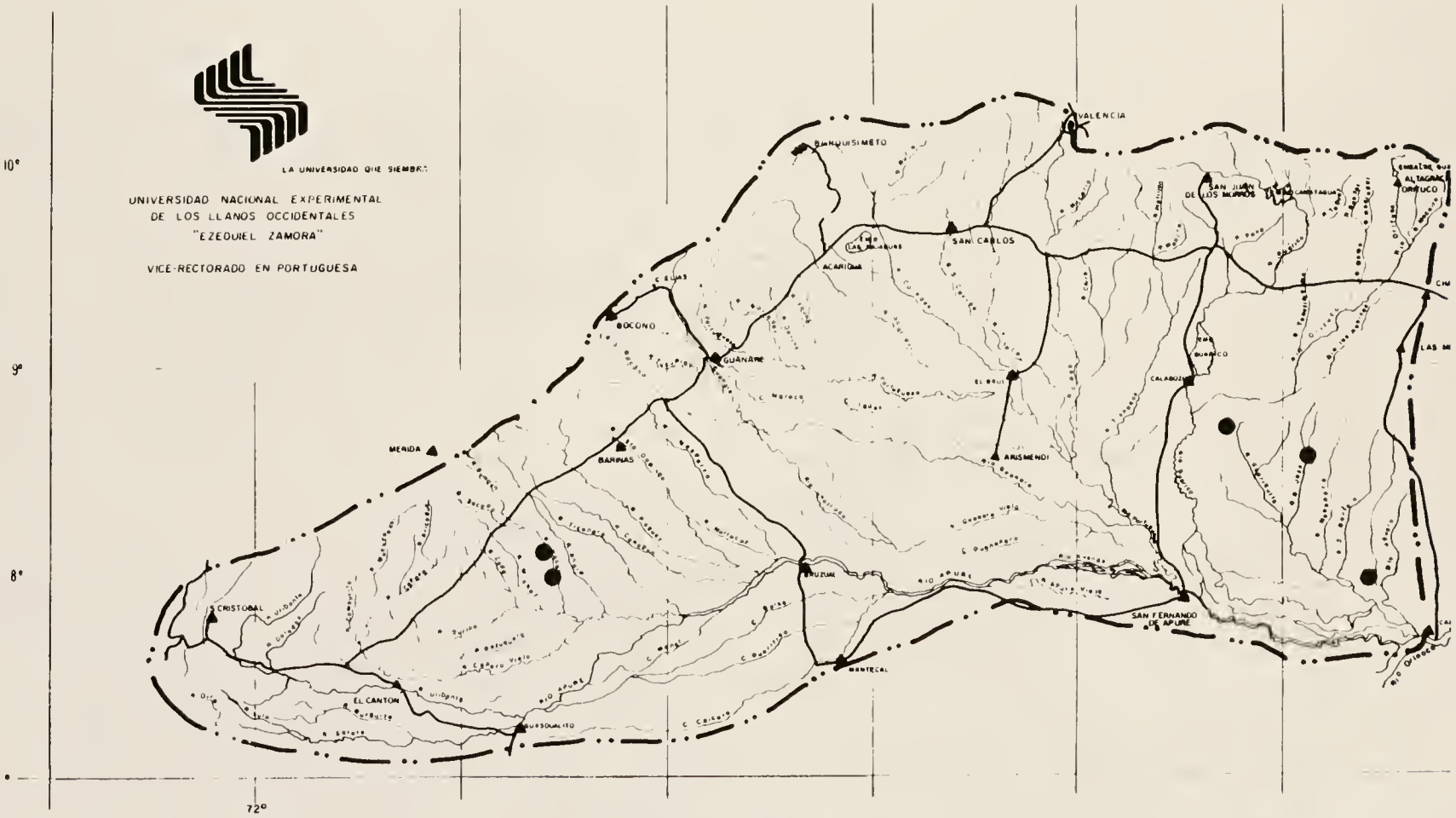


Figure 173. Moenkhausia chrysargyrea.

Figure 174. Apure drainage distribution of *Moenkhausia chrysargyrea*.



CUENCA DEL RIO APURE

Morphology. The body is deep, highly compressed and subrhomboidal. The interorbital width is about equal to the eye diameter. The scales are deeply imbricate, and the lateral line is complete.

Counts. DR 11; AR 27-30; LLS 33-35; PDS 10; premaxilla with 4-5 teeth in outer row, 5-6 pentacuspid teeth in inner; maxilla with 1-2. GR 14.

Measurements. HL 3.5-4 in SL; GBD 2 (in adults) to 2.4 in young.

Pigmentation. This fish is iridescent silvery, with a deep-lying, well-defined, horizontally oval, circular, or rhomboidal black spot over the space between the fifth to the eighth scale of the lateral line. A second, faint humeral spot is sometimes present but there is no caudal spot.

Distribution and Natural History

Range. It occurs in Guyana and Venezuela.

Apure distribution. Map: fig. 174. Two disjunct population have been found. One in Barinas state near Socopó, the other in Guárico, in the Aguaro River system.

Habitat. It inhabits quiet llaneran waters.

Abundance. UNCOMMON.

Number of specimens examined. 38 from 6 collections.

Food. OMNIVORE.

Reproduction. Strategy: rl. It probably spawns throughout the rainy season.

Importance. Ornamental.

Moenkhausia copei (Steindachner) 1882

Bobita, Sardinita - Cope's Tetra

Fig. 175. Map: fig. 176. Couplet 81a.

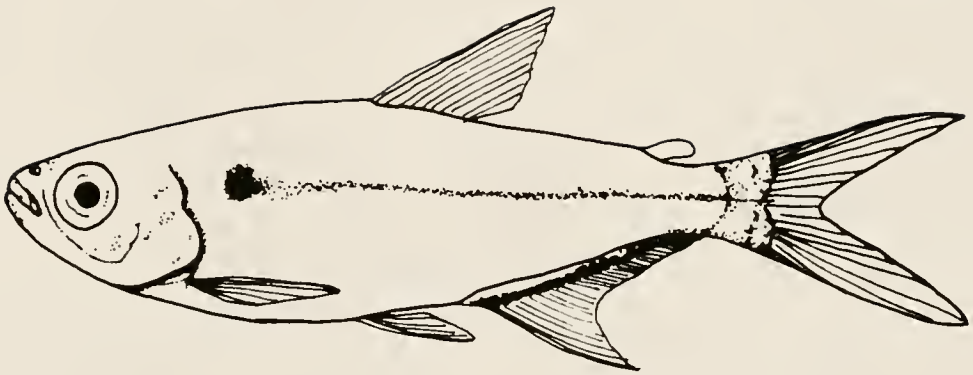


Figure 175. Moenkhausia copei.

Specific synonymy

Tetragonopterus copei Steindachner 1882:179 (type locality: Santarem), seen; 1883:35.

Moenkhausia copei Eigenmann 1910:439; 1917:pl. 101; 1918:pl.9 (key, redescription); Mago L. 1970:71; Géry 1977:424, 442, 446.

Comments. Two very similar sympatric species, M. copei and M. collettii, were described by Steindachner from Brazil, and included in the faunal work of Guyana by Eigenmann (1912). Eigenmann later described the very similar (if indeed not identical) Hemigrammus barrigonae from Barrigona, Colombia, in the Andean foothills drained by tributaries of the Meta River. It seems that since then the three species have often been confused. The most common form in the Apure drainage is elongate and slender, and has black pigment of the lateral stripe not extending onto the base of the caudal rays. I am calling this species M. copei, in keeping with recent work published (Machado A. 1987). The other deeper-bodied species has black pigment on the base of the central caudal rays, and is usually much less common when they occur together. This species is either M. collettii (type locality middle Amazon, Brazil) or H. barrigonae. It is interesting to note that both of the latter species are reported to have variable development of the lateral line, which in some individuals is incomplete, and in others is nearly complete. Since completeness of the lateral line has been a primary feature used in defining a number of genera of small characoid fishes, it becomes clear that this character needs to be reevaluated.

Although there are some differences in the counts of anal-fin rays and gill rakers between Eigenmann's different works on these characids and Apure drainage specimens, they are slight and the type series are small. I have opted to use the name H. barrigonae for the deeper bodied species, since the sometimes incomplete lateral line would appear to fit a Hemigrammus

better than a Moenkhausia (at least as currently understood) and because it is described from the same basin. A detailed comparison of material from all along the Andean Piedmont and into Guyana and Brazil is needed in order to determine if these taxa represent a cline or a complex of species.

Etymology. COPEI = to honor Edward Drinker Cope, North American ichthyologist and paleontologist.

Description

Illustrations. Fig. 175.

Diagnosis. This species is distinguished from other members of the genus by the pigmentation pattern (see Pigmentation below). It is very similar to Hemigrammus barrigonae, but is more elongate and has fewer scales between the lateral line and the dorsal-fin origin (5 vs 6-7).

Size. It can grow to about 60 mm SL, but most individuals are between 40-50.

Morphology. The lateral line is variable but usually complete.

Counts. DR 11; AR 19-20; LLS 31-34; TS 10-13; PDS 10-12; GR 10. 4-5 teeth on outer premaxillary row, 5 in inner.

Measurements. GBD 31-38% SL; HL 28% SL; PDL 51% SL.

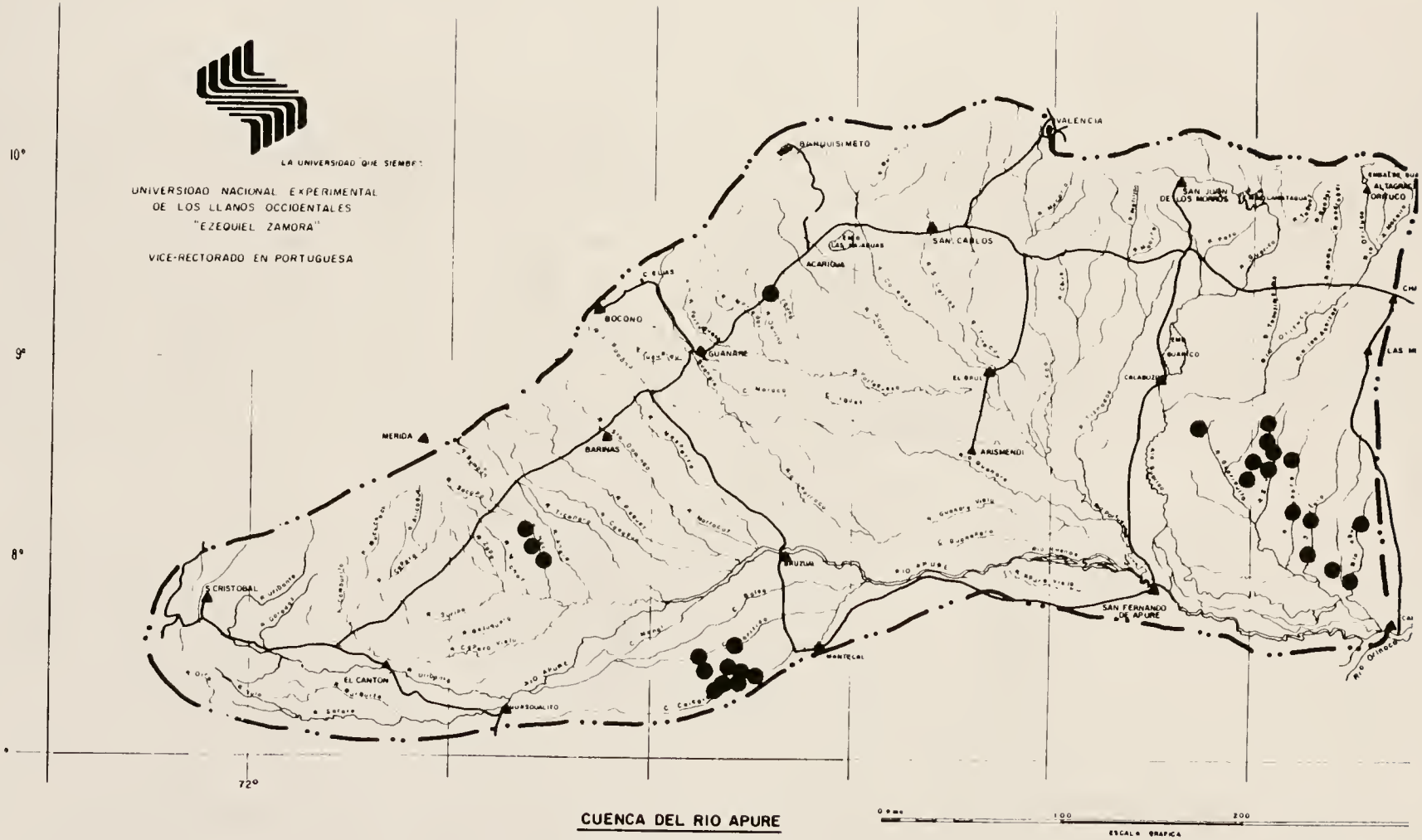
Pigmentation. The characteristic marking of this species is the thin black line above the anal-fin base. There is usually no caudal spot as such, and the lateral stripe ends on the caudal peduncle and does not extend onto the central caudal-fin rays. The humeral spot is well defined. The unpaired fins are tinged with red in life.

Distribution and Natural History

Range. It occurs in the Orinoco and Amazon basins, and in Guyana.

Apure distribution. Map: fig. 176. It is known from isolated populations in Barinas state near Socopó, in northern Apure state west of Mantecal, and in the Aguaro River drainage.

Figure 176. Apure drainage distribution of *Moenkhausia copei*.



CUENCA DEL RIO APURE

Habitat. It inhabits blackwater streams.

Abundance. COMMON.

Number of specimens examined. 1,378 from 42 collections.

Food. OMNIVORE. It eats microcrustaceans, insects, and seeds.

Reproduction. Strategy: r1. It probably spawns throughout the rainy season.

Importance. Ornamental.

Moenkhausia dichroura (Kner) 1859

Sardinita Tijeras - Scissor-Tail Tetra

Figs. 60 (caudal pattern) & 177. Map: fig. 178. Couplet 95a.

Specific synonymy

Tetragonopterus dichrourus Kner 1859:80 (type locality: Río Guaporé, Caicara, Paraguay), seen.

Salmo lambari Natterer in Kner 1859:177 (name in text).

Poecilurichthys dichrourus Eigenmann & Kennedy 1903:522.

Moenkhausia dichrourus Eigenmann 1907:138; 1910:438.

Moenkhausia dichroura Bertoni 1914:12 (Paraguay); Eigenmann 1912:326; 1917:95; Mago L. 1970:71; Géry 1977:429, 442, 446, 450, 502 (key).

Moenkhausia dicroura (error) Schindler 1939:288 (Paraguay).

Moenkhausia intermedia Román 1985:429 (Venez.).

Etymology. DI = two, CHROURA = colors, probably referring to the distinctive tail with black and white.

Description

Illustrations. Fig. 60 (caudal fin) & 177; Axelrod et al. 1971:F-406.00; Géry 1977:429; Román 1985:175, (as M. intermedia).

Diagnosis. The caudal pigmentation pattern (fig. 60) is diagnostic for this species. It could be confused with Hemigrammus marginatus, but the latter has an incomplete lateral line.

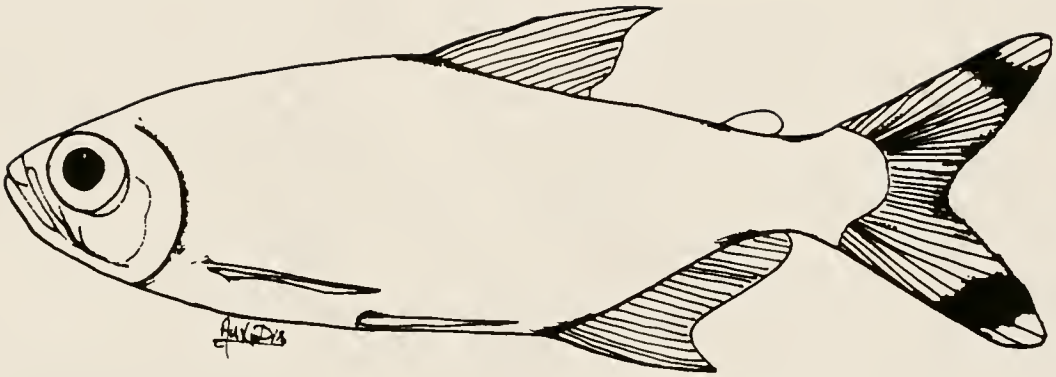
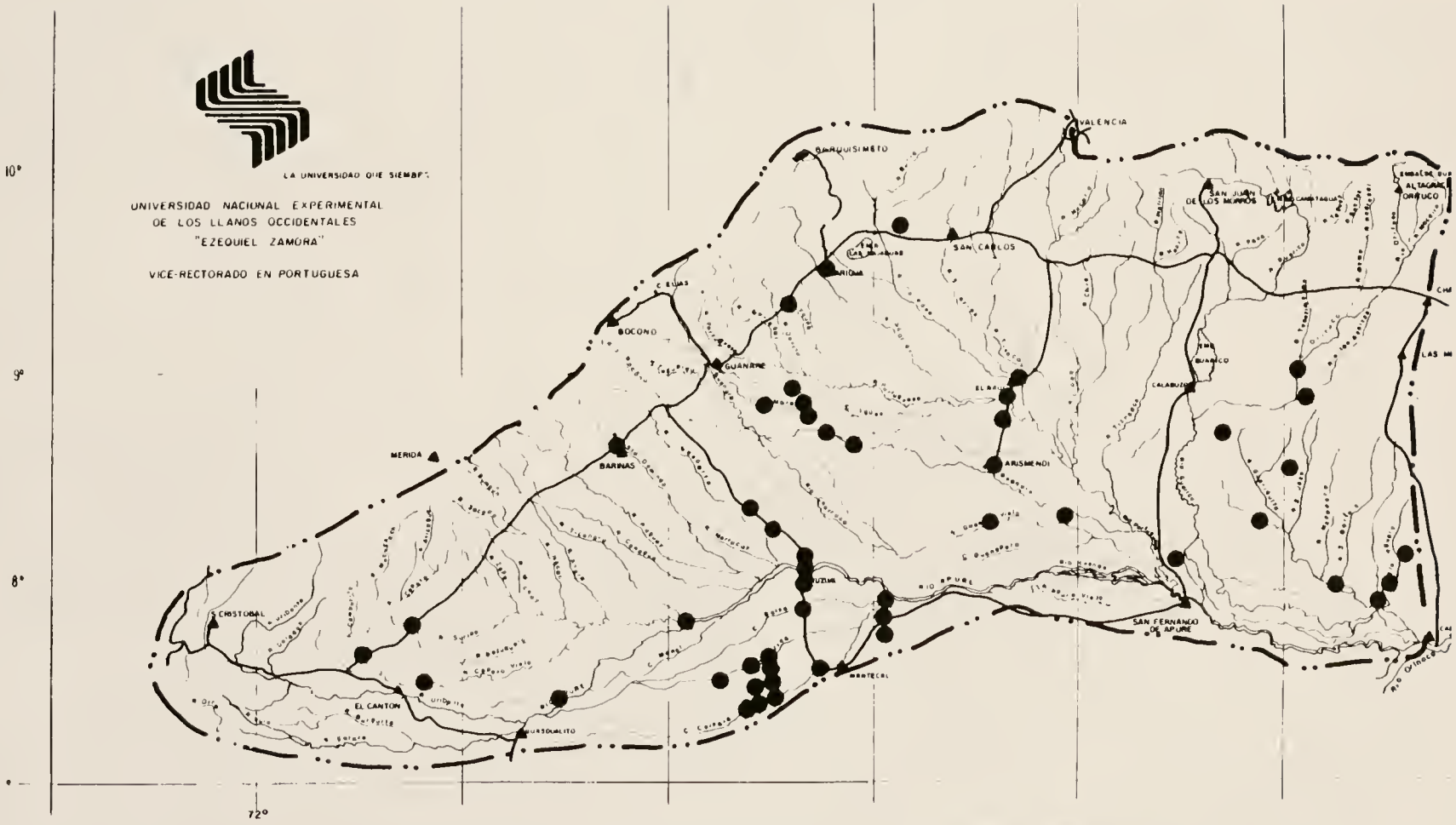


Figure 177. Moenkhausia dichroura.

Figure 178. Apure drainage distribution of *Moenkhausia dichroura*.



CUENCA DEL RIO APURE

Size. The reach about 75 mm TL, but are more commonly taken at around 40 mm.

Morphology. The body is elongate but not spindle shaped, and slightly compressed. The lateral line is complete.

Counts. DR 11; AR 28; LLS 34.

Pigmentation. The body is silvery and the fins are clear except for the caudal, which is yellowish and has each milk-white tipped lobe crossed with a black bar (fig. 60).

Distribution and Natural History

Range. It is widespread from Venezuela to Paraguay.

Apure distribution. Map: fig. 178. This species is known from both llaneran and piedmont streams.

Habitat. It occurs in lowland llanos.

Abundance. COMMON.

Number of specimens examined. 2,210 from 118 collections.

Food. OMNIVORE. It feeds on seeds and insects.

Reproduction. Strategy: r1. It probably spawns throughout the rainy season.

Importance. Ornamental, but quite sensitive to handling.

Moenkhausia lepidura complex (Kner) 1859

Sardinita - Tetra

Fig. 60 (caudal pattern) & 179. Map: fig. 180. Couplets 80a & 95b.

Specific synonymy

Tetragonopterus lepidurus Kner 1859:40 tab. 8, fig. 20 (type locality: Río Guaporé), seen; *Moenkhausia lepidurus* Eigenmann 1910:438.

Moenkhausia lepidura Eigenmann 1912:326; 1917:98 (key, description, list of subspecies); Géry 1977: 428, 432, 442, 451 (key).

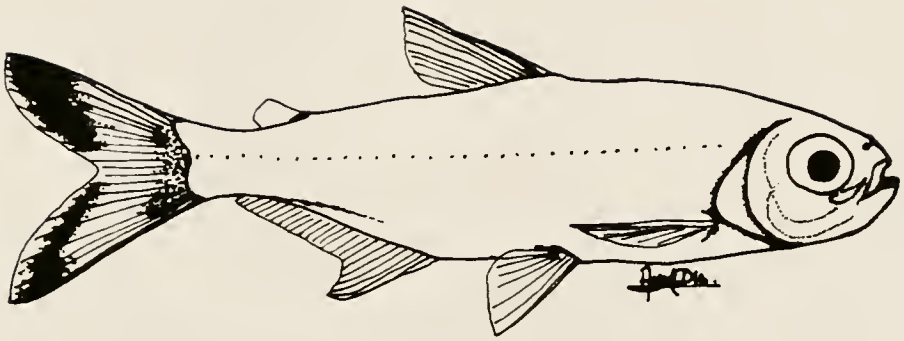


Figure 179. Moenkhausia lepidura complex.

Comments. This species is part of a complex of species that all have similar color patterns. Several subspecies have been named, but confusion still exists because of a lack of adequate comparative material and brief, incomplete descriptions.

Etymology. LEPIDU = from the Latin "lepidus" for pleasant, neat or pretty; URA = from the Greek "oura" for tail.

Description

Illustrations. Fig. 60 (caudal pattern) & 179; Eigenmann 1917:pl. 8, fig. 2; Géry 1977:428.

Diagnosis. This species could be confused with *M. dichroura* or *Hemigrammus marginatus*. It differs in having only the upper caudal-fin lobe darkly pigmented, instead of both. It is also similar to *Bryconops melanurus*, but is distinguished in having a shorter maxilla and fewer lateral-line scales (about 35 vs 43-45).

Size. It can reach almost 110 mm SL, but most individuals are smaller, 40-80 mm.

Morphology. The body is long and slender but not particularly compressed.

Counts. DR 11; LS about 35; AR about 29; GR 9.

Measurements. HL 3.75-4.4 in SL; GBD 3-3.5 in SL.

Pigmentation. The caudal fin has a dark edge on the upper lobe, and is orange near its base.

Distribution and Natural History

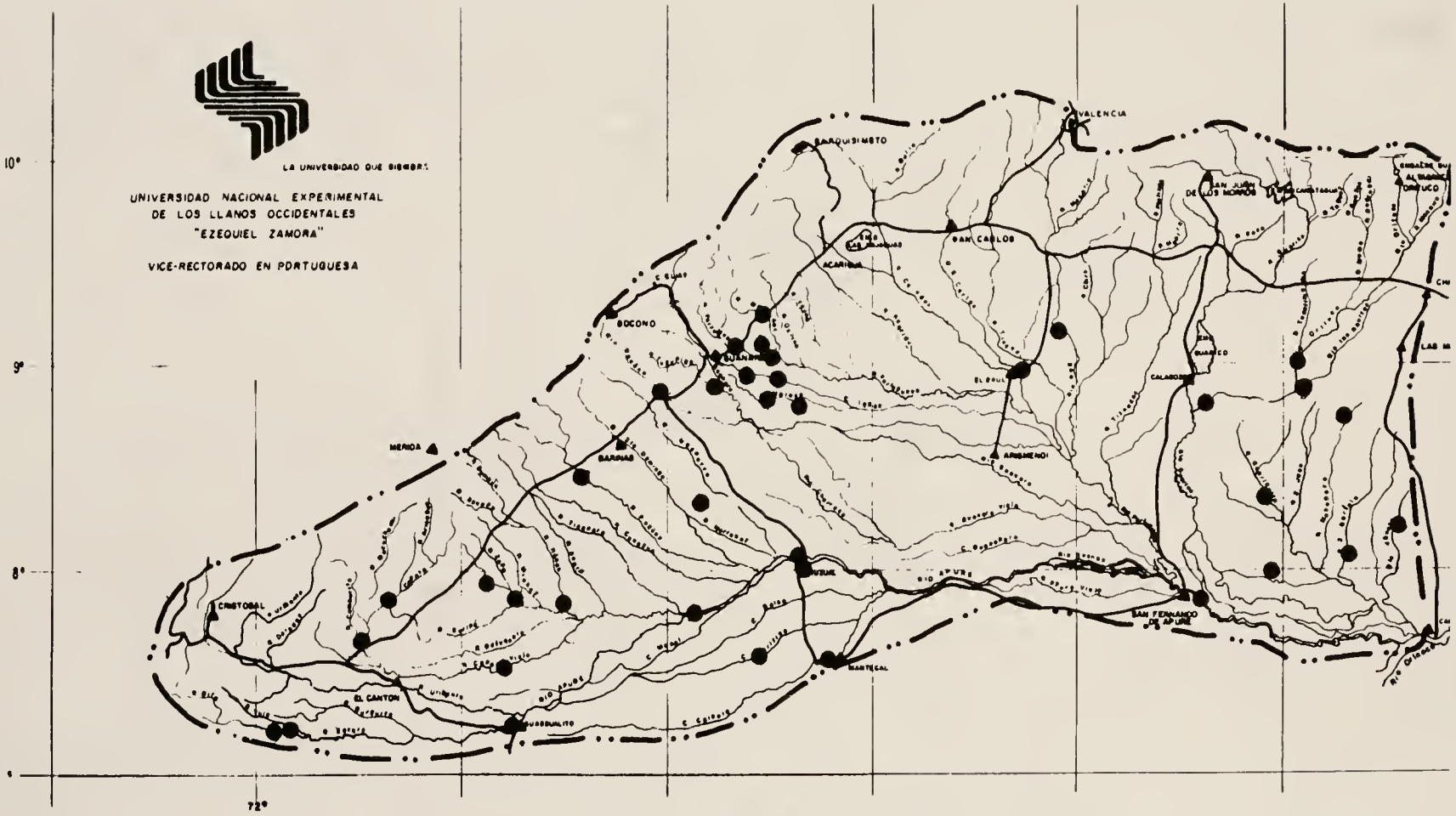
Range. It occurs in the Amazon and Orinoco basins, and in Guyana.

Apure distribution. Map: fig. 180. It occurs only in the llanos.

Habitat. *M. lepidura* lives in streams of the lowland llanos.

Abundance. COMMON.

Figure 180. Apure drainage distribution of Moenkhausia lepidura complex.


LA UNIVERSIDAD QUE DIGNIFICA
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
MERIDA
BARINAS
ARAUCA
CRISTOBAL
EL CANTON
SAN FERNANDO DE APURE
RIO APURE
CALABOZO
SAN JUAN DE LOS MORROS
CUENCA DEL RIO APURE
ESCALA GRAFICA

Number of specimens examined. 722 from 44 collections.

Food. OMNIVORE.

Reproduction. Strategy: rl. It probably spawns throughout the rainy season.

Importance. Ornamental.

Myleus cf pacu (Schomburgk) 1841

Palometa - Pacu, Silver Dollar

Fig. 181. Map: fig. 182. Couplet (not in key).

Generic synonymy

Myleus Müller & Troschel 1844:98 (type species: Myleus setiger Müller & Troschel 1844, (= Myleus pacu Schomburgk 1841), by subsequent designation of Eigenmann 1910:443).

Tometes Valenciennes in Cuvier & Valenciennes 1849:225 (type species: Tometes trilobatus Valenciennes 1849, (= Myleus pacu Schomburgk 1841), by subsequent designation of Jordan 1919:242).

Myloplus Gill 1896:214 (type species: Myletes asterias Müller & Troschel, by subsequent designation of Jordan (1920), proposed as substitute for Myletes of Müller & Troschel).

Orthomyleus Eigenmann 1903:148 (type species: Myletes ellipticus Günther, by original designation).

Paramyloplus Norman 1929:828 (type species: Paramyloplus ternetzi Norman 1929, by original designation).

Prosomyleus Géry 1972:182 (type species: Myletes rhomboidalis Cuvier 1818, by original designation).

Specific synonymy

Myletes pacu Schomburgk 1841:236, pls. 20-21 (type locality: Guyana), seen.

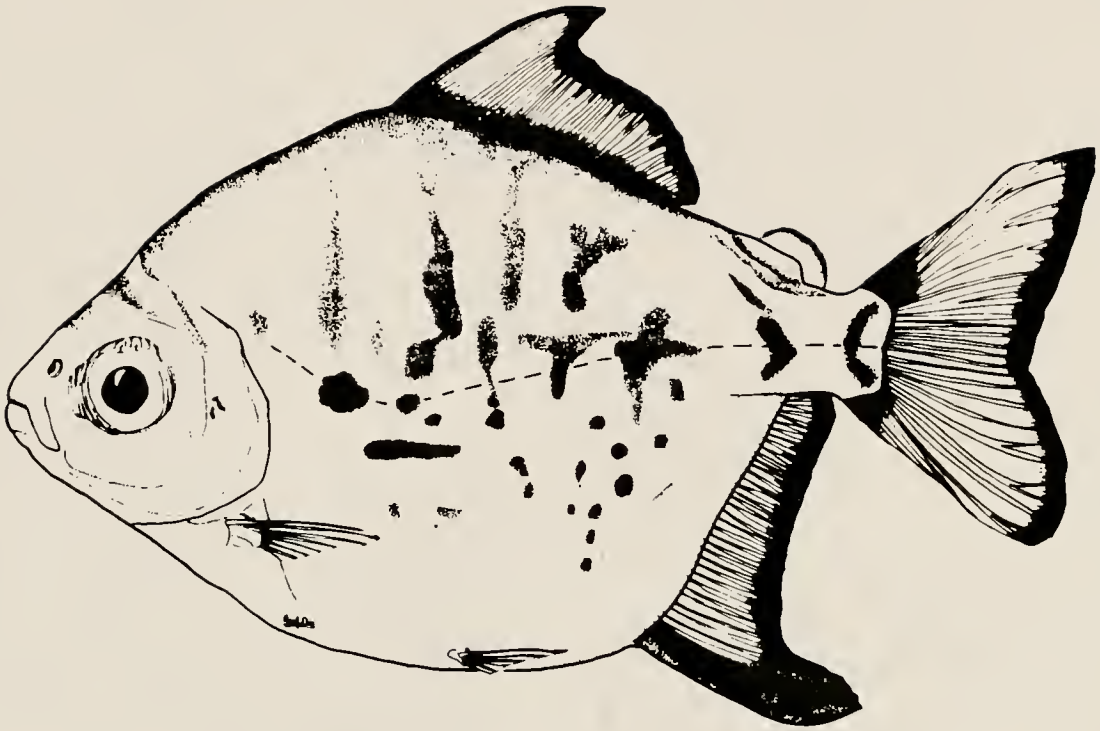


Figure 181. Myleus cf pacu.

Myleus setiger Müller & Troschel 1844:98 (Guyana).

Myletes setiger Günther 1864:378 (Guyana).

Myletes schomburgki (non Jardine in Schomburgk) Müller & Troschel 1844:98.

?Myletes divaricatus Valenciennes in Cuvier & Valenciennes 1849:215 (type locality: Essequibo).

Tometes trilobatus Valenciennes in Cuvier & Valenciennes 1849:27 (type locality: Cayenne).

Tometes unilobatus Valenciennes in Cuvier & Valenciennes 1849:27 (type locality: Cayenne).

Myletes rhomboidalis (non Cuvier) Pellegrin 1908:28.

Myleus pacu Eigenmann 1912:393 (Guyana).

Myleus (Myleus) pacu Géry 1972:178 (diagnosis, synonymy); 1977:266 (diagnosis).

Comments. Because only one juvenile specimen, tentatively identified here as Myleus pacu (a species hitherto known only from Guyana), was captured, this species was not included in the key. That specimen would key out with the Mylossoma species, but has more ventral serrae (28-46 vs 10-22). The similar Myleus micans is present in morichal habitats in other parts of Venezuela (Machado Allison, pers. com.), but differs from M. pacu in various meristic characters (Géry 1977). Since even the identification of adults is difficult in this group, this name is only tentative, pending collection of larger specimens from the Aguaro River.

Etymology. MYLEUS = like a mill stone; PACU = is the common name of this species in Guyana.

Description

Illustrations. Fig. 181; Myers 1972:57; Géry 1977:264.

Diagnosis. The two species of Myleus known from the Apure drainage are easily distinguished by the dorsal-fin ray count, about iii20 in

M. cf pacu and iii26-29 in M. rubripinnis. This species is further distinguished by the following combination of characters: front teeth compressed, close-set, sharp cutting incisors, appressed against the inner molariform teeth (Géry 1977); anal-fin rays iii31.

Size. It reaches at least 600 mm SL (Géry 1977).

Morphology. The body is discoid.

Counts. There are 28-47 ventral serrae (the number increases with age) (Géry 1977).

Pigmentation. The juvenile specimen collected during this study is gray dorsally, whitish to silvery ventrally, and with faint irregular darker vertical bars on the upper sides. Adults are reported to be plain as adults, though they have large red spots on the sides during the breeding season (Géry 1977).

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins, and in Guyana.

Apure distribution. Map: fig. 182. This species is known from one locality in the Aguaro River system.

Habitat. The specimen collected was taken from a blackwater stream with abundant aquatic vegetation, in the low llanos.

Abundance. RARE.

Number of specimens examined. 1 from 1 collection.

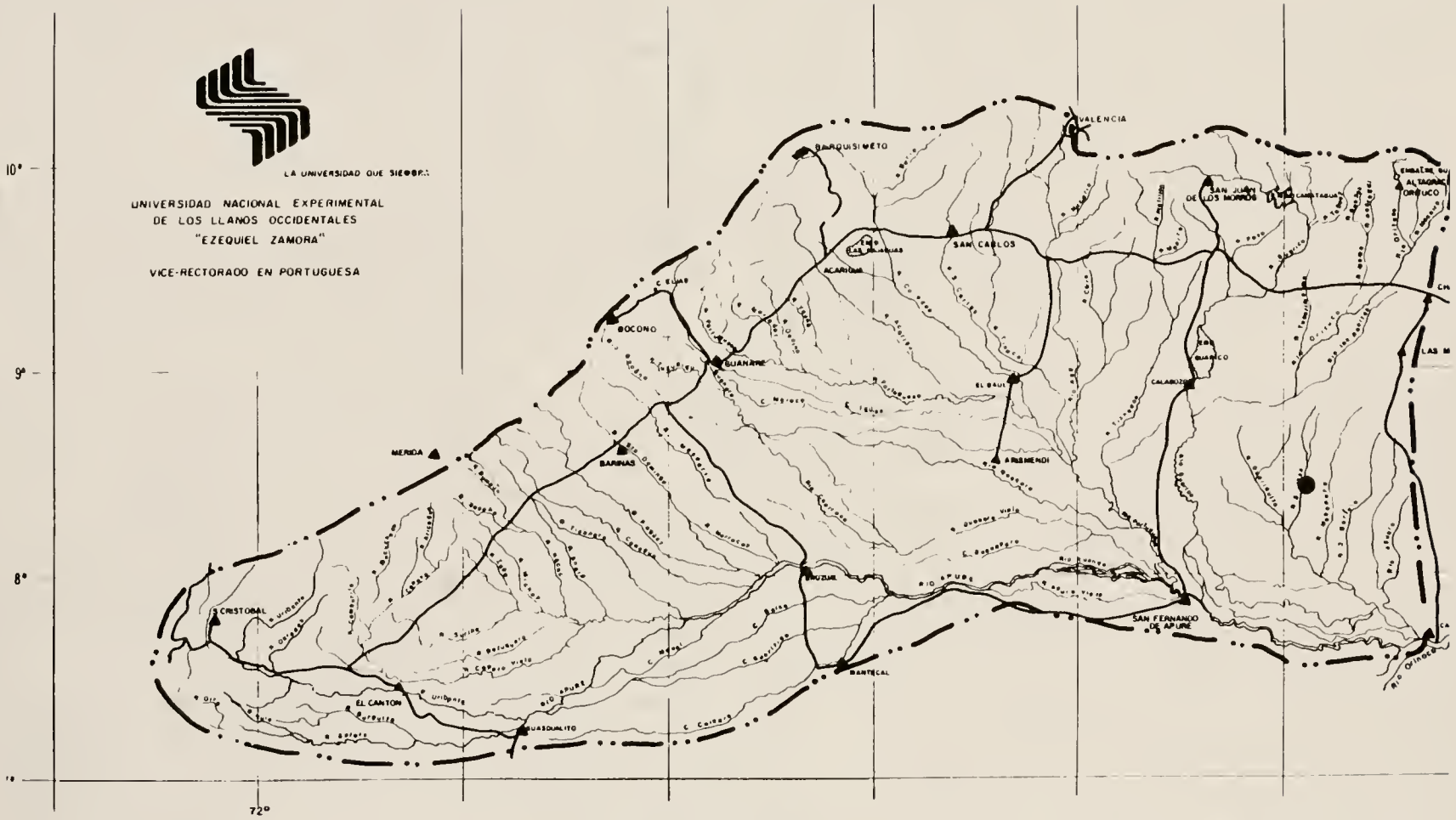
Food. OMNIVORE. It is mostly vegetarian.

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June.

Migrations. It probably migrates at the end of rainy season to avoid drought conditions.

Importance. Ornamental.

Figure 182. Apure drainage distribution of *Myleus* cf *pacu*.



CUENCA DEL RIO APURE

Esc. 1 2 000000

Myleus rubripinnis (Müller & Troschel) 1844

Palometa Gancho Rojo - Redhook Metynnis

Fig. 183. Map: fig. 184. Couplet 18a.

Specific synonymy

Myletes rubripinnis Müller & Troschel 1845:97 (type locality: Guiana).

Myloplus rubripinnis Eigenmann 1912:391 (Guyana); Fowler 1950:404 (synonymy, range); Mago L. 1970:72.

Myleus rubripinnis Eigenmann 1910:443.

Myleus (Myloplus) rubripinnis Géry 1972:162 (diagnosis, synonymy); 1977:262 (key, subspecies).

Etymology. RUBRI= red, PINNIS = fins.

Description

Illustrations. Fig. 183; Fowler 1951:405; Géry 1977:263; Axelrod et al. 1971:F-420.12.

Diagnosis. The high number of dorsal-fin rays (29 or more), and the elongate, hooked anal-fin of the male distinguish this species from the all other discoid characids in the Apure drainage.

Size. It matures at about 90-120 mm (Axelrod et al. 1971), but can get somewhat larger.

Morphology. The body is discoid. A distinctive red hooked anal fin is present in adult males.

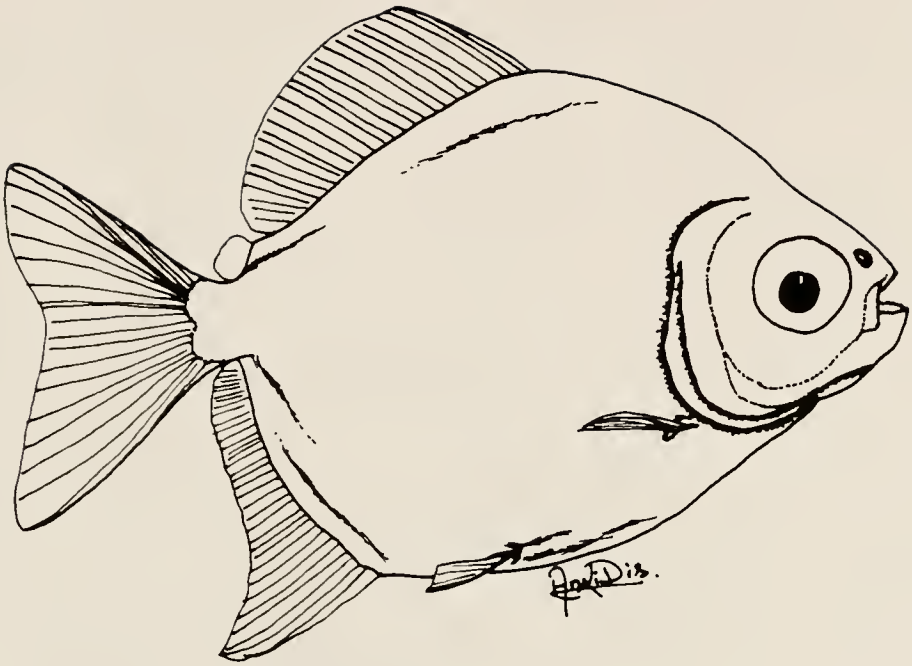
Counts. DR iii26 to iii29; AR iii32-36.

Pigmentation. The body is silvery and the anal fin red. Breeding males have brilliant patches of orange, red or yellow on the sides.

Distribution and Natural History

Range. It occurs in the Orinoco and Amazon basins.

Apure distribution. Map: fig. 184. It is known from Caño Caicara in northern Apure state west of Mantecal, and the Aguaro River system.



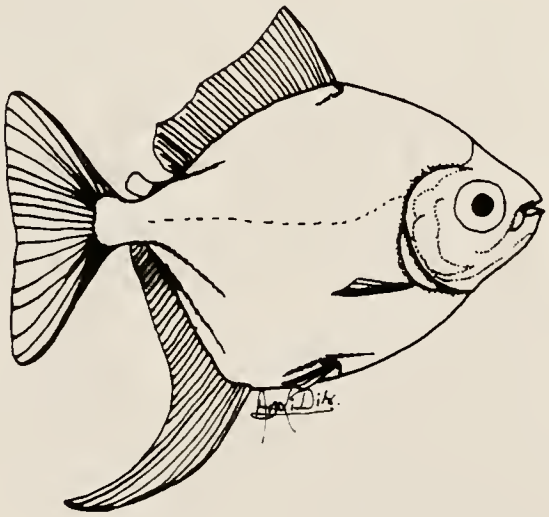
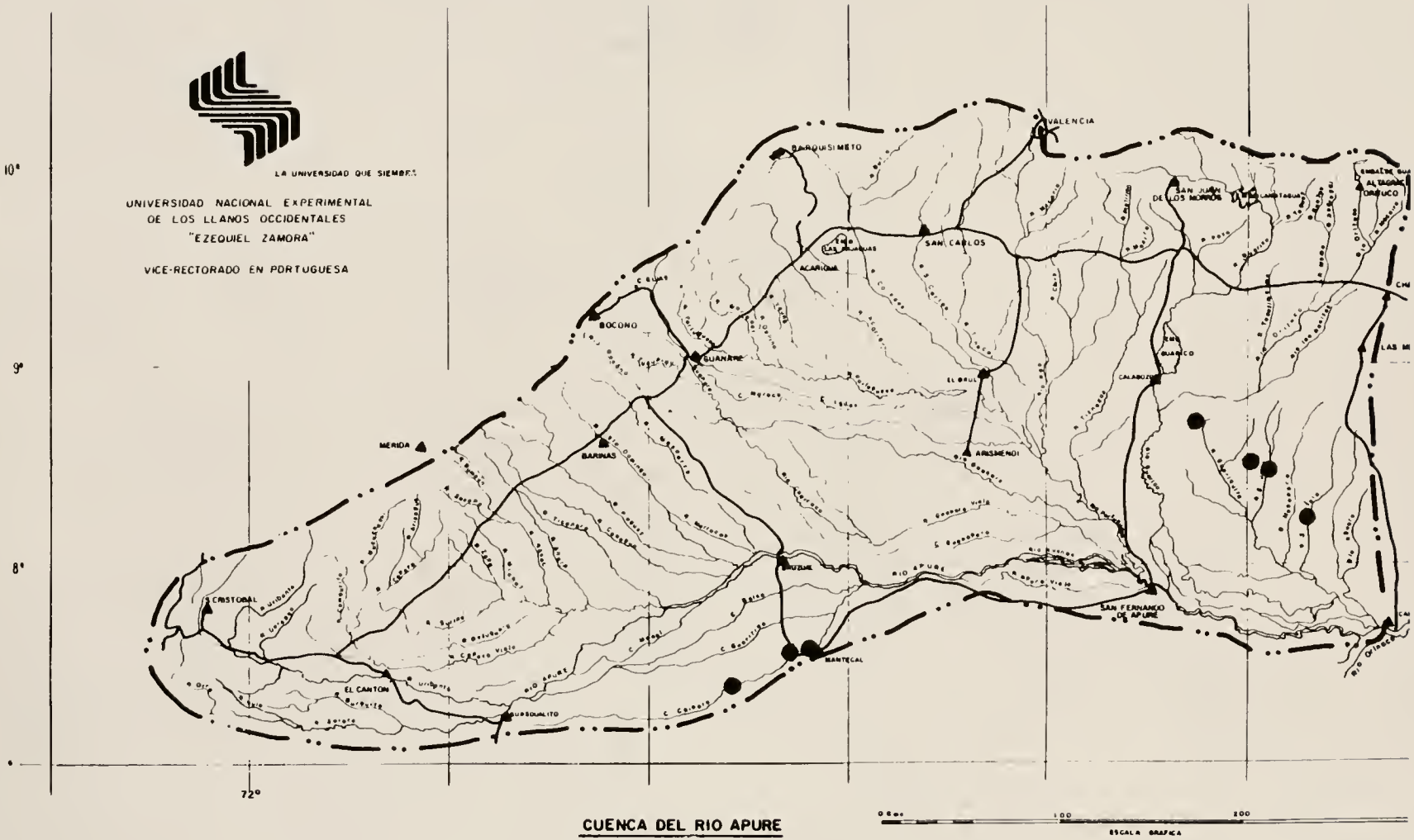


Figure 183. Myleus rubripinnis. A mature male is shown below.

Figure 184. Apure drainage distribution of *Myleus rubripinnis*.



CUENCA DEL RIO APURE

Habitat. It lives in the low llanos, in blackwater streams, with abundant aquatic vegetation.

Abundance. UNCOMMON.

Number of specimens examined. 13 from 10 collections.

Food. OMNIVORE. It is mostly herbivorous.

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June. Males are distinguished by having the central rays of the anal fin elongated and hooked. In captivity, 300-500 eggs per females are scattered randomly about the tank. The embryos hatch in about 50-60 hours, absorb the yolk-sac over a period of 3-7 more days, and then begin to feed on plankton (Axelrod et al. 1971).

Migrations. Since this is a fairly large fish, dry-season migrations to avoid drought conditions may be expected, but have not yet been documented in the Apure drainage.

Importance. Ornamental.

Mylossoma aureum (Spix) 1829

Palometa Dorada - Golden Palometa

Fig. 185. Map: None. Couplet 31b.

Generic synonymy

Mylossoma Eigenmann & Kennedy 1903:530 (type species: Myletes albiscopus Cope, by monotypy).

Mylosoma Eigenmann 1915:261 (alternative spelling).

Starksina Fowler 1906:476 (type species: Myletes herniarius Cope, by monotypy).

Specific synonymy

Myletes aureus Spix in Agassiz 1829:74 (type locality: Equatorial rivers of Brazil), seen.

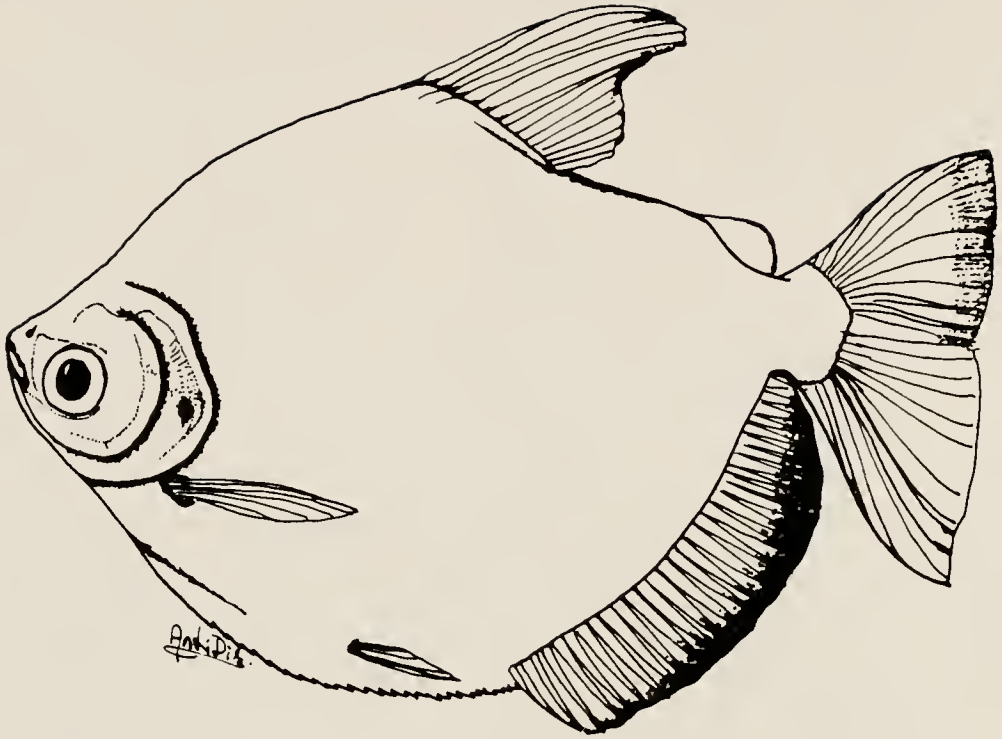


Figure 185. Mylossoma aureum.

Tetragonopterus aureus Spix in Agassiz 1829:74 pl. 31.

Mylosoma aureum Eigenmann 1910:444.

Mylosoma aureus Eigenmann 1915:265 (Brazil).

Mylossoma aureus Pearson 1925:48 (Bolivia).

Mylossoma aureum Norman 1928:812 (Orinoco, Amazon); Eigenmann and Allen 1942:249 (Orinoco to Ucayali and La Plata); Schultz 1944b:258; Fowler 1945:168; Mago L. 1970:72; Géry 1977:258-9, 261.

Myletes herniarius Cope 1872:268, pl. 12 fig. 3 (type locality: Río Ambyiacu, Peru).

Starksina herniarius Fowler 1907:476, fig. 56 (types).

Colossoma herniarium Eigenmann 1910:444.

Mylossoma herniarium Ahl 1922: non-paginated.

Myletes albiscopus (not of Cope) Boulenger 1898:426 (Río Jurúa) (part).

?Metynnis unimaculatus Steindachner 1908:326 (type locality: lake near Río Medonho, trib of R. Parnaiba, north of Santa Filomena).

Mylossoma duriventris (not of Cuvier) Ahl 1922 (figures only).

Comments. This is something of a "mystery fish," since it is always cited, but few specimens in collections are identified as such. I suspect that it goes unnoticed among the more common M. duriventris.

Etymology. MYLOS = millstone, SOMA = body; AUREUM = golden.

Description

Illustrations. Fig. 185; Fowler 1951:407 fig. 451 (type of Myletes herniarius Cope; Myers 1972:41; Román 1985:115.

Diagnosis. Mylossoma species differ from Colossoma in possessing a heavily scaled anal fin (vs scaled only at base), in having only four teeth on each side of the lower jaw (vs six or more), and in having more than 35 anal-fin rays (vs less than 30). They are distinguished from the other

large discoid serrasalmine genera (for example Myleus and Metynnis) in lacking the predorsal "spine" that is embedded in the flesh just anterior to the dorsal-fin origin in those genera.

Mylossoma aureum differs from Mylossoma duriventris in having fewer serrae behind the pelvic fins (10-16 vs 18-22), with the last one not close to the first anal-fin ray; in having only 28-34 branched anal-fin rays (vs about 37), and in having a relatively shorter adipose-fin base measuring 3.75-4.25 times in the dorsal-fin base length versus 2.6-3.66 (Géry 1977).

Size. It grows to about 300 mm SL.

Morphology. It is plate-shaped, very deep-bodied and compressed.

Counts. DR ii13-15.

Measurements. GBD 70% SL.

Pigmentation. The body is silvery to golden.

Distribution and Natural History

Range. It occurs from the Orinoco in Venezuela to the Ucayali and La Plata in Brazil.

Apure distribution. Map: No specimens were collected during this study, but many have been collected by fishery biologist Otto Castillo from around San Fernando de Apure and (pers. com.).

Habitat. It inhabits large river channels and llaneran creeks with abundant overhanging shore vegetation. It often seeks refuge in submerged brush piles near shore.

Abundance. RARE. The relative scarcity of this species may be more a reflection of its ability to avoid capture with the equipment used, rather than true rarity. It is not as common as M. duriventris, and the two are difficult to distinguish without careful examination.

Number of specimens examined. 0.

Food. OMNIVORE. It is mainly vegetarian, taking both leafy aquatic macrophytes as well as fruits and seeds.

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June.

Migrations. It probably makes biannual migrations, upstream at the beginning of the dry season, and back downstream with the onset of the rains.

Importance. It is fished commercially and by sport fishermen along with the more common M. duriventris.

Mylossoma duriventris (Cuvier) 1818

Palometa - Silver Dollar

Fig. 186. Map: fig. 187. Couplet 31a.

Specific synonymy

Myletes duriventris Cuvier 1818:451:pl. 22, fig. 2 (type locality: Brazil), seen; ?Peters 1877:473 (Calabozo, Venez.).

Myletes duriventre Steindachner 1917:pl. 6 figs 1-3.

Myletes (Mylosoma) duriventris Steindachner 1917:55 (Río Negro).

Mylossoma duriventris Ahl 1922: non-paginated (2 figs.); Schultz 1944b:258; Mago L. 1970:72; Novoa et al. 1982:271 (biology).

Mylossoma duriventre Campos 1944:207 (Río Miranda).

Myletes albiscopus Cope 1872:267, pl. 12 fig. 1 (type locality: Río Ambyiacu).

Mylossoma albiscopus Eigenmann & Kennedy 1903:530 (Paraguay).

Mylosoma albiscopus Eigenmann 1910:444; 1915a:266.

Mylossoma albiscopum Eigenmann & Allen 1942:250.

Mylossoma ocellatum Eigenmann 1915a:264 (type locality: Villa Hayes, Paraguay).

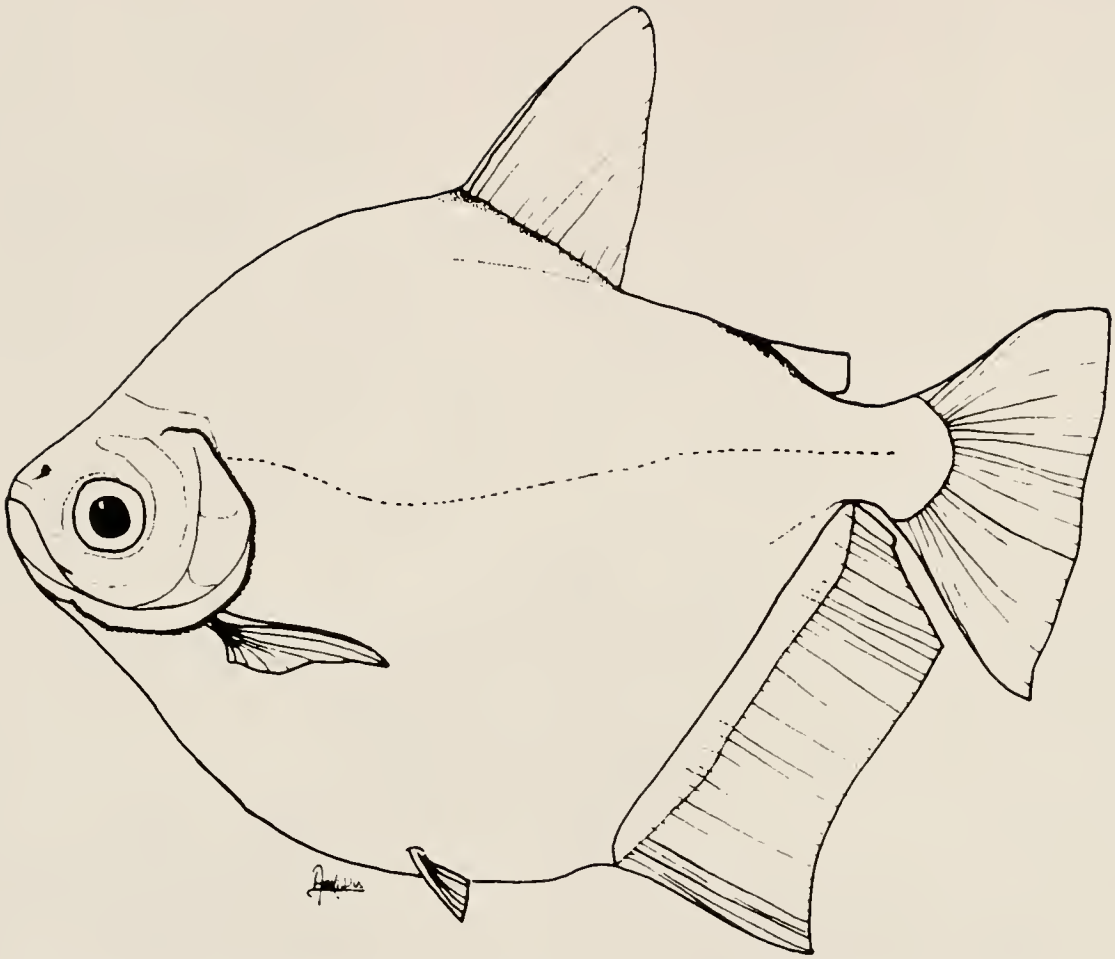


Figure 186. Mylossoma duriventris.

Etymology. DURI= hard, VENTRIS = ventrum, probably referring to the spiny serrae on the ventral edge of body.

Description

Illustrations. Fig. 186; Géry 1977:261; Machado A. 1982:fig. 6 (juvenile); Novoa et al. 1982:fig. 7.

Diagnosis. See preceding diagnosis for M. aureum.

Size. It can reach 340 mm TL, and 1.1 kg (Novoa et al. 1982).

Morphology. The body is disk-shaped.

Counts. DR ii13-15; AR about 37.

Pigmentation. The body is silvery, sometimes with a bit of yellow on the abdomen. The fins are clear.

Distribution and Natural History

Range. It occurs in the Orinoco, Amazon, and La Plata basins.

Apure distribution. Map: fig. 187. It is common in the larger creeks and rivers of the llanos.

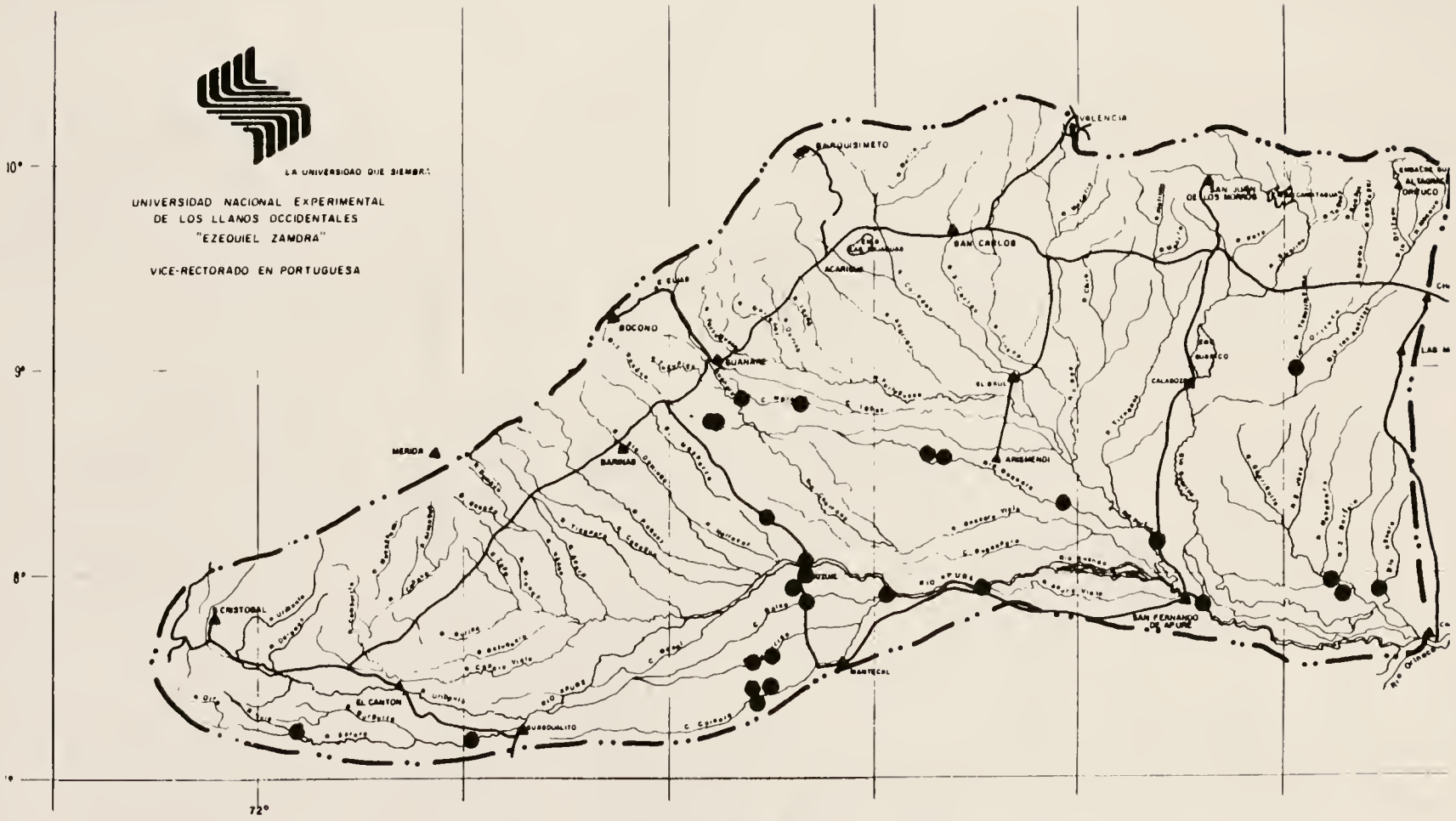
Habitat. It is found in large creeks and rivers during the dry season, and in lowland flooded areas (bajios and esteros) during the wet season.

Abundance. COMMON.

Number of specimens examined. 203 from 49 collections.

Food. HERBIVORE. It feeds on seeds, terrestrial vegetation, aquatic vegetation, and flowers. Goulding (1980) noted that the teeth of Mylossoma spp are heavy but have sharper cusps than the teeth of the larger Colossoma and Piaractus, and are thus better suited for slicing and cutting, rather than crushing. It eats smaller seeds and fruits when available, and take leaves and Ceiba seeds during low-water periods in the Amazon Basin when food is scarcer.

Figure 187. Apure drainage distribution of *Mylossoma duriventris*.



CUENCA DEL RIO APURE

Reproduction. Strategy: r2. It is probably synchronized with the onset of the rains in May to June.

Migrations. At the onset of the dry season it moves out of the shallow, flooded areas of the lower floodplain (esteros and bajios) into the main rivers and then travels upstream to more permanent creeks in the piedmont and high llanos that still have their shore vegetation intact. It seeks food and refuge from the gallery forest trees and shrubs.

Importance. It is an important food fish, and is caught commercially and by sport fishermen in huge quantities during their annual upstream migration at the beginning of the drought.

Paragoniates alburnus Steindachner 1876

Sardina Azul - Blue Tetra

Fig. 188. Map: fig. 189. Couplet 6b.

Generic synonymy

Paragoniates Steindachner 1876:114 (type species: Paragoniates alburnus Steindachner, by subsequent designation of Eigenmann 1910:441).

Specific synonymy

Paragoniates alburnus Steindachner 1876:117, pl.8 fig 3. (type locality: Río Amazonas at Teffé), not seen; Böhlke 1958 (description); Mago L. 1970:72; Géry 1977:341, 346, 347 (key).

Etymology. PAR = like, AGONIATES = Agoniates, a genus of characid; ALBURNUS = whitish.

Description

Illustrations. Fig. 188; Román 1985:156; Géry 1977:341.

Diagnosis. This species is characterized by the following combination of characters: dorsal-fin origin behind anal-fin origin; anal-fin long, with 43-49 rays; premaxilla with seven tricuspid teeth

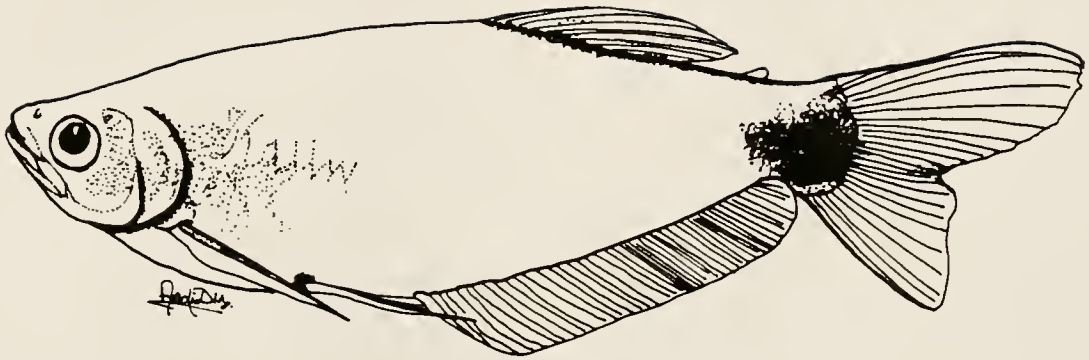


Figure 188. Paragoniates alburnus.

arranged in a single irregular row; maxilla completely toothed with 18-25 small teeth; lateral line incomplete.

Size. It can grow to at least 100 mm SL.

Morphology. The body is moderately deep but elongate and quite compressed.

Counts. DR ii9-ii10; AR 43-49; PR i11-i12; VR i7; TS 14-16; LS 40-43.

Measurements. HL 3.9-4.2 in SL, GBD 2.7-2.9 in SL EYE 3.0-3.3 in HL.

Pigmentation. The sides of the body have a bluish iridescent sheen. The fins are clear to dusky gray. There is a large black blotch at the base of the caudal fin.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 189. It is common in most llaneran streams and rivers.

Habitat. It is usually taken from near shore, among cover or aquatic vegetation, in large creeks or rivers with a moderate to strong current.

Abundance. COMMON.

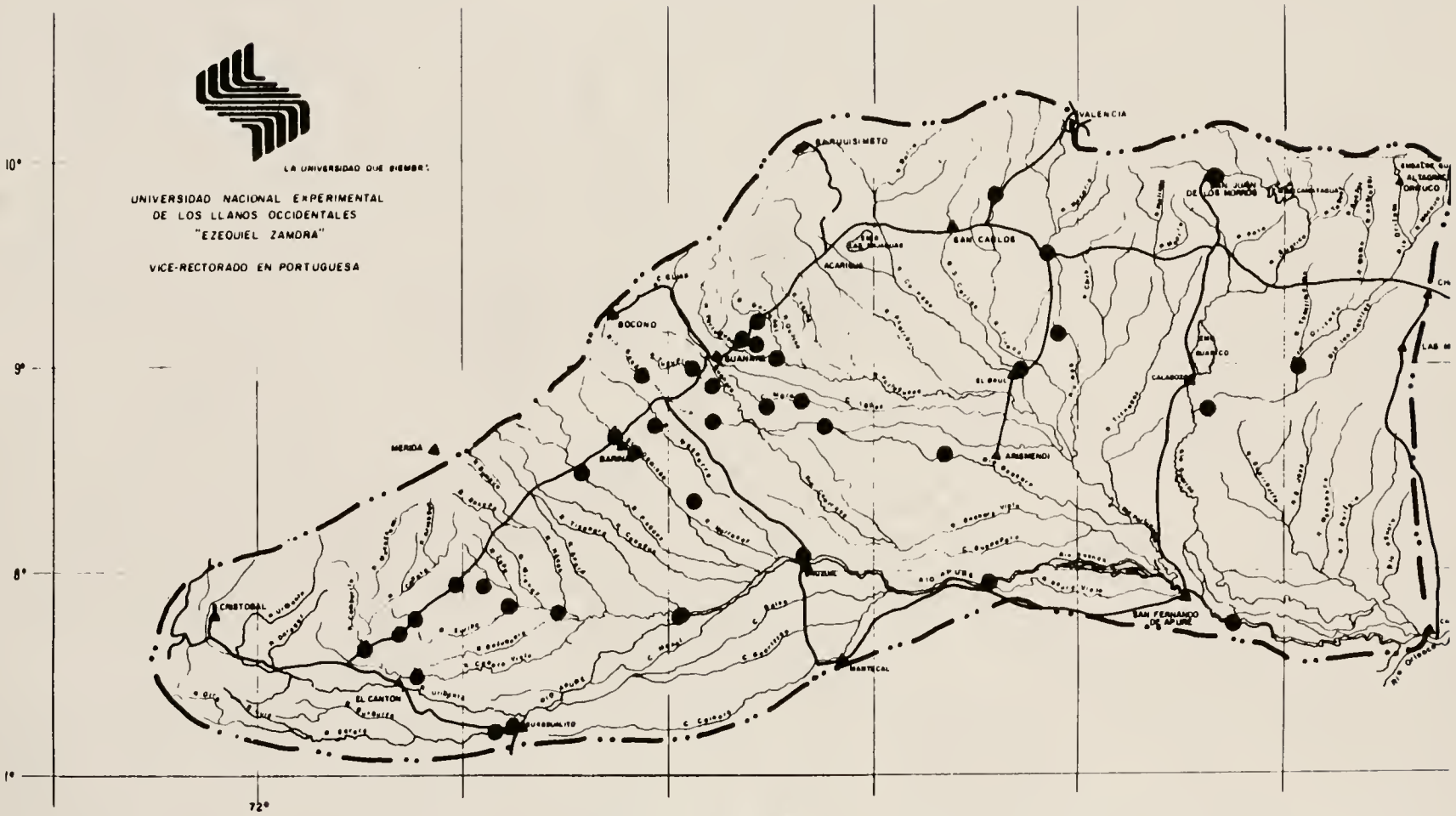
Number of specimens examined. 222 from 61 collections.

Food. CARNIVORE. It feeds on small fish, insects and other invertebrates.

Reproduction. Strategy: r2. It probably spawns at the beginning of the rainy season.

Importance. Ornamental.

Figure 189. Apure drainage distribution of *Paragoniates alburnus*.



CUENCA DEL RIO APURE

Parapristella georgiae Géry 1963

Sardinita - Tetra

Fig. 190. Map: fig. 191. Couplet 34a.

Generic synonymy

Parapristella Géry 1963:25 (type species: Pristella aubynei Eigenmann 1909, by original designation).

Specific synonymy

Parapristella georgiae Géry 1963:25 (type locality: about 200 miles east of Bogotá, Colombia in the upper Río Meta drainage); 1977:487, 504.

Etymology. PARA= like, PRISTELLA = Pristella is a similar genus of Characidae; GEORGIAE = after Dr. Géry's wife.

Description

Illustrations. Fig. 190; Géry 1977:487 (teeth), 504.

Diagnosis. Parapristella georgiae is distinguished by the following combination of characters: maxilla with about seven small tricuspid teeth; caudal-fin base with a triangular spot; anal-fin rays about 16 (fewer than in similar species of Hemigrammus).

This species is easily confused with Hemigrammus micropterus and Serrabrycon magoi which are so similarly marked as to suggest that there may be some sort of mimicry involved. Closer examination reveals significant differences in the number of anal-fin rays and dentition.

Size. It can grow to about 50 mm SL.

Morphology. The lateral line is incomplete.

Counts. DR 11; AR 16; LLS 30. Premaxillary teeth in two rows, 3-4 conical to tricuspid in the outer, 5 pentacuspid in the inner; maxilla with 6-8 tricuspid teeth; dentary with 5 pentacuspid teeth in front and 13 smaller tricuspid ones on sides (Géry 1964).

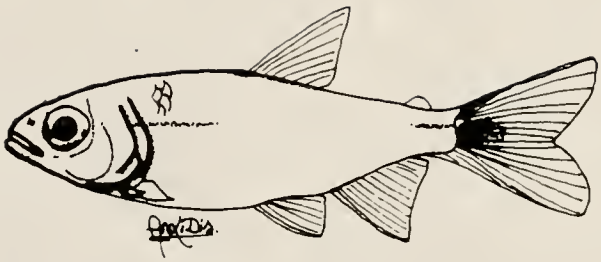
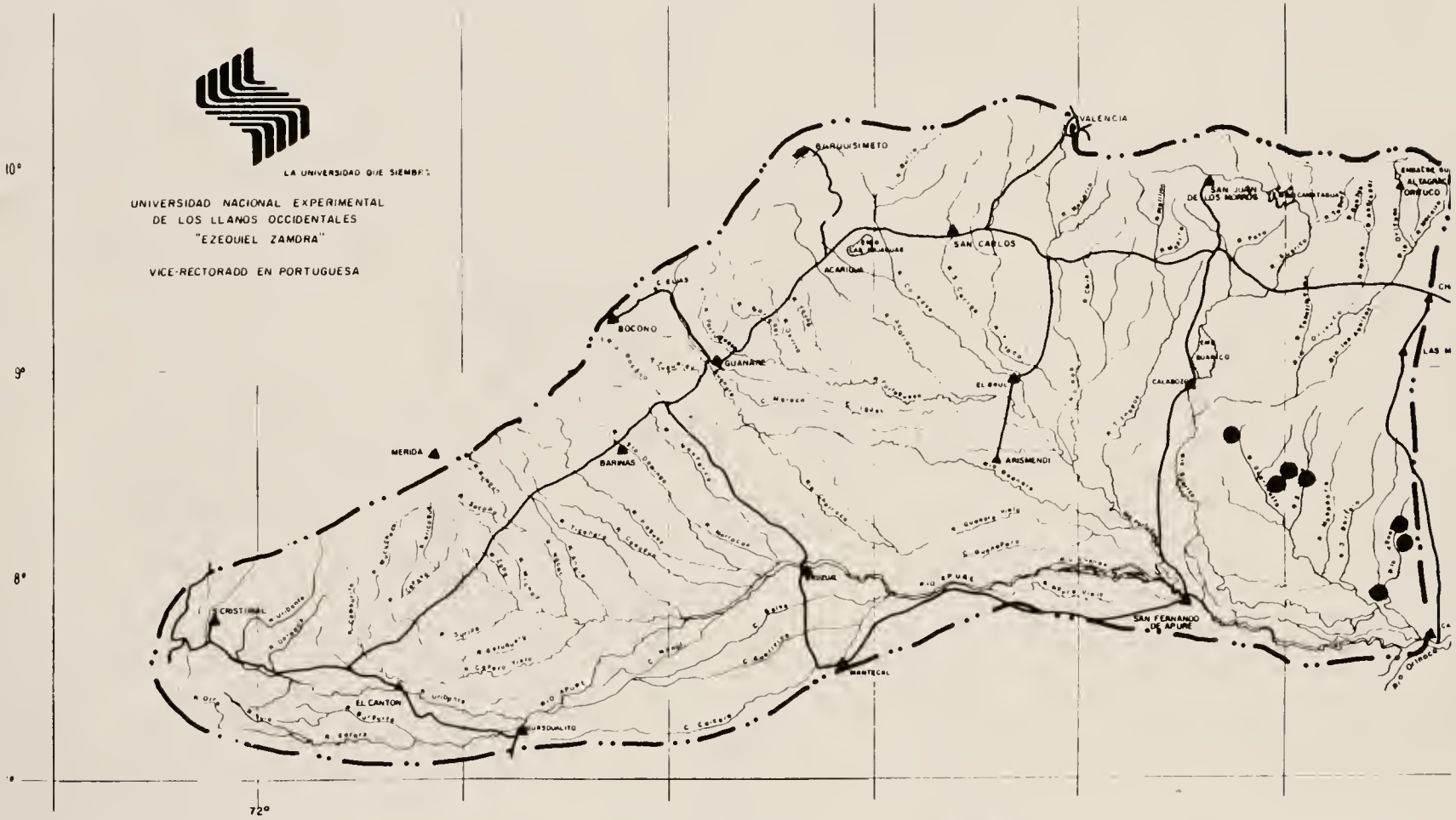


Figure 190. Parapristella georgiae.

Figure 191. Apure drainage distribution of *Parapristella georgiae*.



CUENCA DEL RIO APURE

Measurements. GBD 3.47-3.84 in SL; HL 3.4 in SL.

Pigmentation. The caudal-fin base is marked with a triangular black dot, and with a red dot (in life) that is above and slightly anterior to the black. The dorsum olive-yellow. The dorsal and caudal fins are yellowish.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 191. It has been collected only from the Aguaro River system.

Habitat. It is found in blackwater streams.

Abundance. UNCOMMON.

Number of specimens examined. 462 from 8 collections.

Food. CARNIVORE. It feeds on microcrustaceans and insects.

Reproduction. Strategy: r1. It probably spawns repeatedly throughout the rainy season.

Importance. Ornamental.

Phenacogaster cf megalostictus Eigenmann 1909

Sardinita - Tetra

Fig. 192. Map: fig. 193. Couplet 83a.

Generic synonymy

Phenacogaster Eigenmann 1907:769 (type species: Tetragonopterus pectinatus Cope 1869-70, by monotypy).

Specific synonymy

Phenacogaster megalostictus Eigenmann 1909:28 (type locality: Tumatumari, British Guiana), seen; 1917:195, fig. 2; 1927:pl. 56, fig. 2; Eigenmann & Myers 1929:448 (key, description); Mago L. 1970:72; Géry 1977:530, 548 (key).

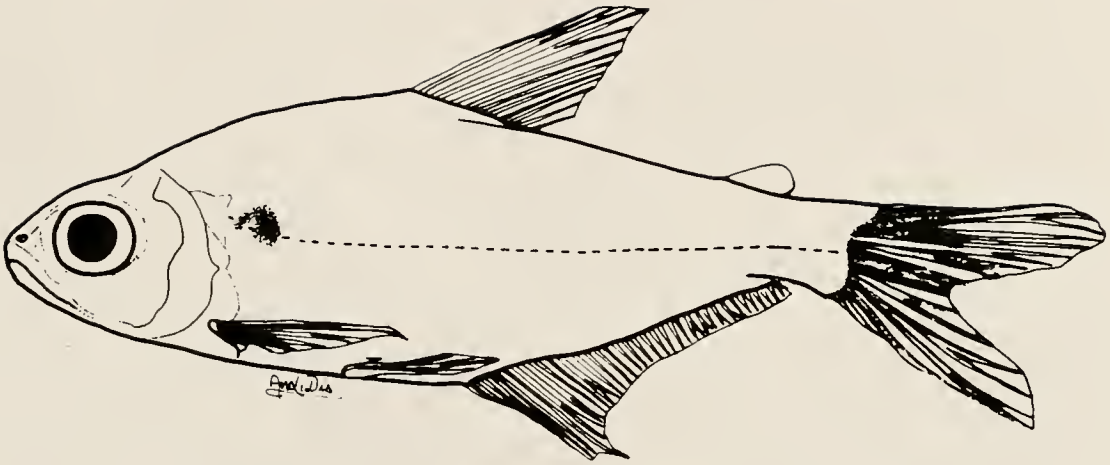


Figure 192. Phenacogaster cf megalostictus.

Types. Holotype: originally CM 1056, now at FMNH. Paratypes: CAS-SU 21906 (2); 21907 (1); CAS 48095(3); 62202(10); 62203(2); 62204(3); 62205(3). I also examined paratypes of P. microstictus CAS 62270(3) and 62271(1).

Comments. This species only superficially resembles P. megalostictus and is probably new. The size and intensity of the humeral spot seems to vary greatly.

Etymology. PHENACO = a cheat, GASTER = belly, referring to the peculiar (reduced in number) scalation of the preventral area (Eigenmann 1929); MEGALO = big, STICTUS = spot, referring to the humeral spot.

Description

Illustrations. Fig. 192; Eigenmann 1929:pl. 56, fig. 2, pl. 95, fig. 2.

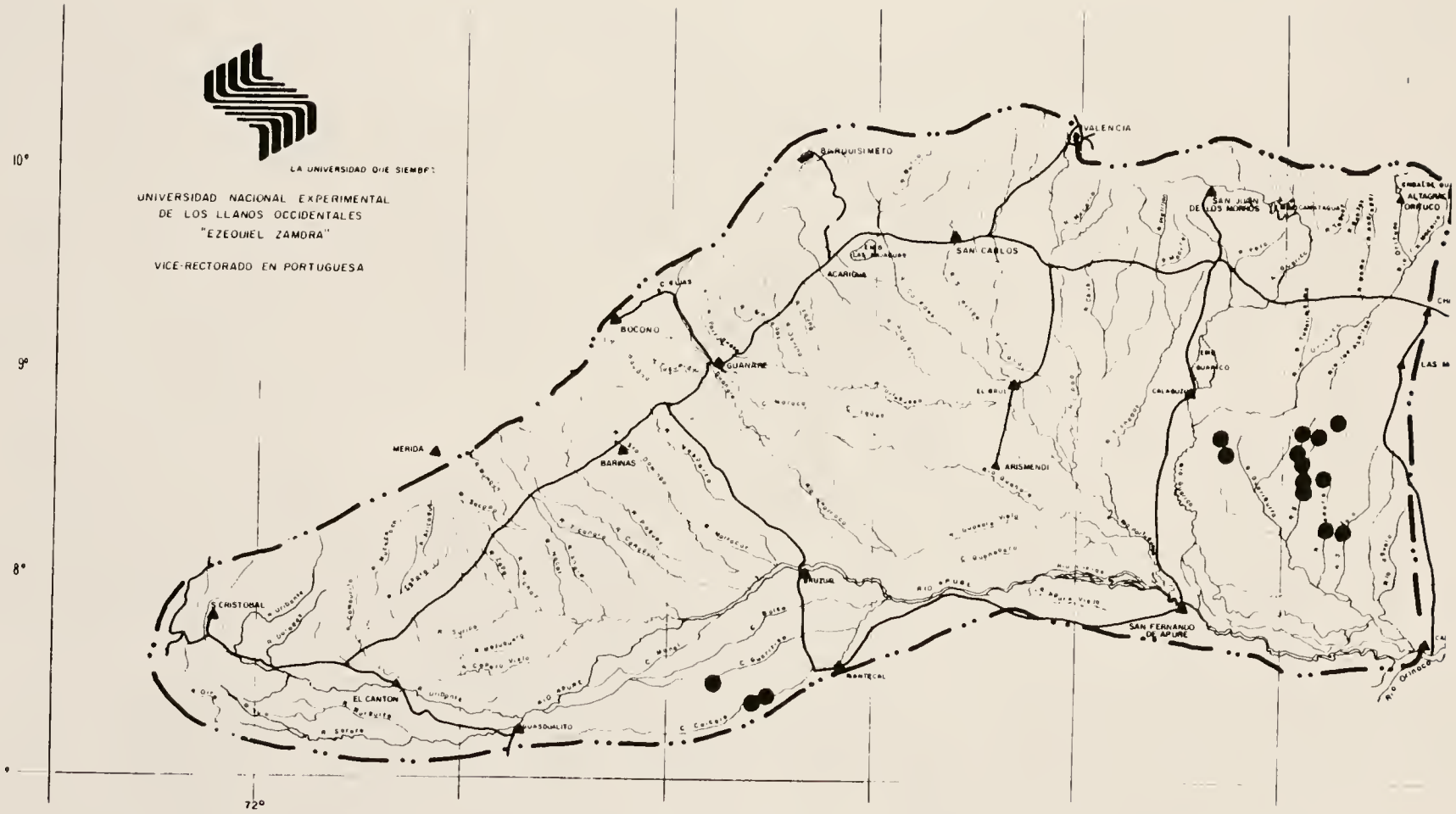
Diagnosis. Phenacogaster cf megalostictus can be recognized by the following combination of characters: anal-fin origin under that of the dorsal fin; scales in front of the pelvic fins enlarged, and in two series that overlap on the midline (midline sometimes with additional small accessory scales); lateral spot usually present, large and circular; teeth in premaxillary rows 4-7 in the outer series, 6-10 in the inner.

Size. It has been reported to reach 85 mm SL in Guyanan specimens (Géry 1977), but the Apure specimens seldom exceed 50.

Morphology. The body is very compressed and elongate, with the posterior portion of body elongated. The lateral line is complete. The preventral area is flat, with two series of large scales overlapping along the middle, and a small auxiliary scale in the angle of each pair of the overlapping scales, except the two pairs between the pectorals.

Counts. DR 11; AR 33-37; LLS 32-36; GR 9.

Figure 193. Apure drainage distribution of Phenacogaster cf megalostictus.



CUENCA DEL RIO APURE

Measurements. HL 3.8-4 in SL; GBD 2.7.

Pigmentation. The body is tan, usually with a rounded black humeral spot (the spot is often diffuse, faded or even absent in some preserved material).

Distribution and Natural History

Range. It is known from the Essequibo, Orinoco and Amazon basins.

Apure distribution. Map: fig. 193. It has been found only in northern Apure state and in the Aguaro River system.

Habitat. It inhabits blackwater streams of the low llanos.

Abundance. UNCOMMON.

Number of specimens examined. 183 from 17 collections.

Food. CARNIVORE. It probably feeds on microcrustaceans, small fish, and insects.

Reproduction. Strategy: r1. It is probably an egg scatterer that spawns repeatedly throughout the rainy season.

Importance. Ornamental.

Piaractus brachypomus (Cuvier) 1818

Cachama - Giant Pacu

Fig. 39b (operculum) & 194. Map: 195. Couplet 30b.

Generic synonymy

Piaractus Eigenmann 1903: 148 (type species: *Myletes brachypomus* Cuvier 1818, by original designation).

Reganina Fowler 1906:475 (type species: *Myletes bidens* Agassiz 1929, by original designation).

Waiteina Campos 1946:219 (type species: *Waiteina fowleri*, by original designation).

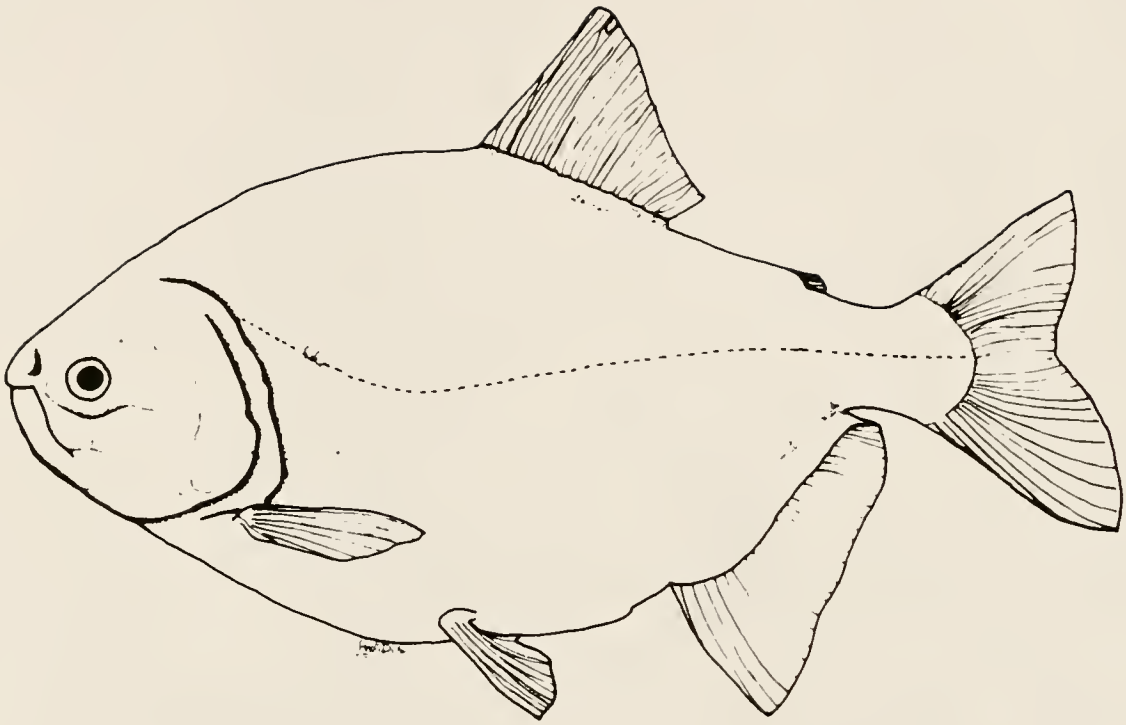


Figure 194. Piaractus brachypomus.

Specific synonymy

Myletes brachypomus Cuvier 1818:452, pl. 22, fig. 1 (type locality: Brazil), seen; Valenciennes in Cuvier & Valenciennes 1849:199 (redescription of holotype).

Myletes pacu (not of Schomburgk 1841) Humboldt 1817:175, pl. 47, fig. 2 (type locality: Río Amazonas, Brazil); Salmo pacu Kner 1860:21 (name in text).

Myletes bidens Agassiz in Spix & Agassiz 1829:75, pl. 32 (type locality: rivers of equatorial Brazil);

Colossoma brachypomus Norman 1928:809 (key, synonymy, Amazon); Schultz 1944b (Río Caripe, near Caripito, Venez.).

Piaractus brachypomus Eigenmann 1903:148; Eigenmann & Allen 1942:247 (range); Machado A. 1982:47 (redescription, range, synonymy).

Reganina bidens Fowler 1906:475.

Colossoma bidens Eigenmann 1910:444; Fowler 1945:167 (synonymy, range);

Waiteina fowleri Campos 1946:219, fig. 2 (type locality: Río Tapajos, Brazil.

Colossoma brachypomum Fowler 1950:388 (synonymy, range); Novoa et al. 1982:268 (biology).

Colossoma brachipomus (error) Román 1985:115 (Venez.).

Types. Holotype: MNHN A.8626.

Comments. As the synonymy indicates, the generic placement of this species has varied a great deal through the years. The most recent treatment is that of Machado A. (1982), who is revising the subfamily Serrasalminae. He recognized only two valid species in this genus, including this species and P. mitrei (Berg) 1895.

Etymology. PIAR = fat, ACTUS = a ray, from the Greek; BRACHY = wide, POMUS = cheek.

Description

Illustrations. Fig. 39b (opercle) & 195; Géry 1977:252; Machado A. 1982: (holotype and juvenile phases); Novoa et al. 1982:fig. 5, (as Colossoma brachypomum); Román 1985:115 (as Colossoma brachipomus).

Diagnosis. There are only two giant characids, this species and Colossoma macropomum. Piaractus brachypomus has more lateral-line scales (78-90 vs 67-76); a narrower opercle (fig. 39), and lacks ossified rays in the adipose fin. The adipose fin gradually degenerates and is completely lost in the largest individuals (Machado A. 1982).

Size. This is one of the largest characids in Venezuela. A 450 mm specimen measured fresh weighed 3.1 kg. Novoa et al. (1982) reported a maximum size of 790 mm TL from the Orinoco delta region. Specimens as large as 40 kg have been reported by fishermen.

Counts. DR ii-iii13-15 (15-18); AR iii-iv21-24 (24-28); PR i15-18 (16-19); VR i7; Caudal Rays i-9+8-i; LLS 70-90; TS 22-30 above LL, 22-33 below; GR 26 to 39, increasing with size of specimen.

Measurements. GBD 47-67% SL; HL 29-50% SL (Machado A. 1982).

Pigmentation. Very small juveniles have ovate spots and a small ocellus on the sides that disappear at about 60 mm SL. A black opercular spot is present in specimens up to about 100 mm SL. Medium-sized juveniles mimic Pygocentrus caribe with their bright red abdomen. In adults, the body is dark gray or brown on the dorsum and sides with a whitish abdomen. A few individuals have orange to reddish spots on the abdomen. Older specimens are darker, usually dark brown but sometimes jet-black.

Distribution and Natural History

Range. It occurs from the Orinoco to the La Plata Basin.

Apure distribution. Map: fig. 195. It is common in the larger rivers and streams throughout the llanos.

Habitat. These fish move from habitat to habitat with ease, spending part of their time in main channels, but also exploring side creeks, and flooded areas for fruit dropped from trees.

Abundance. COMMON. Though the few collections don't in themselves warrant this classification, this species was once one of the most frequently observed fishes in the local markets. It is seldom taken with small seines. Its abundance is declining according to commercial catches recorded in San Fernando de Apure by Otto Castillo (pers. com.).

Number of specimens examined. 31 from 15 collections.

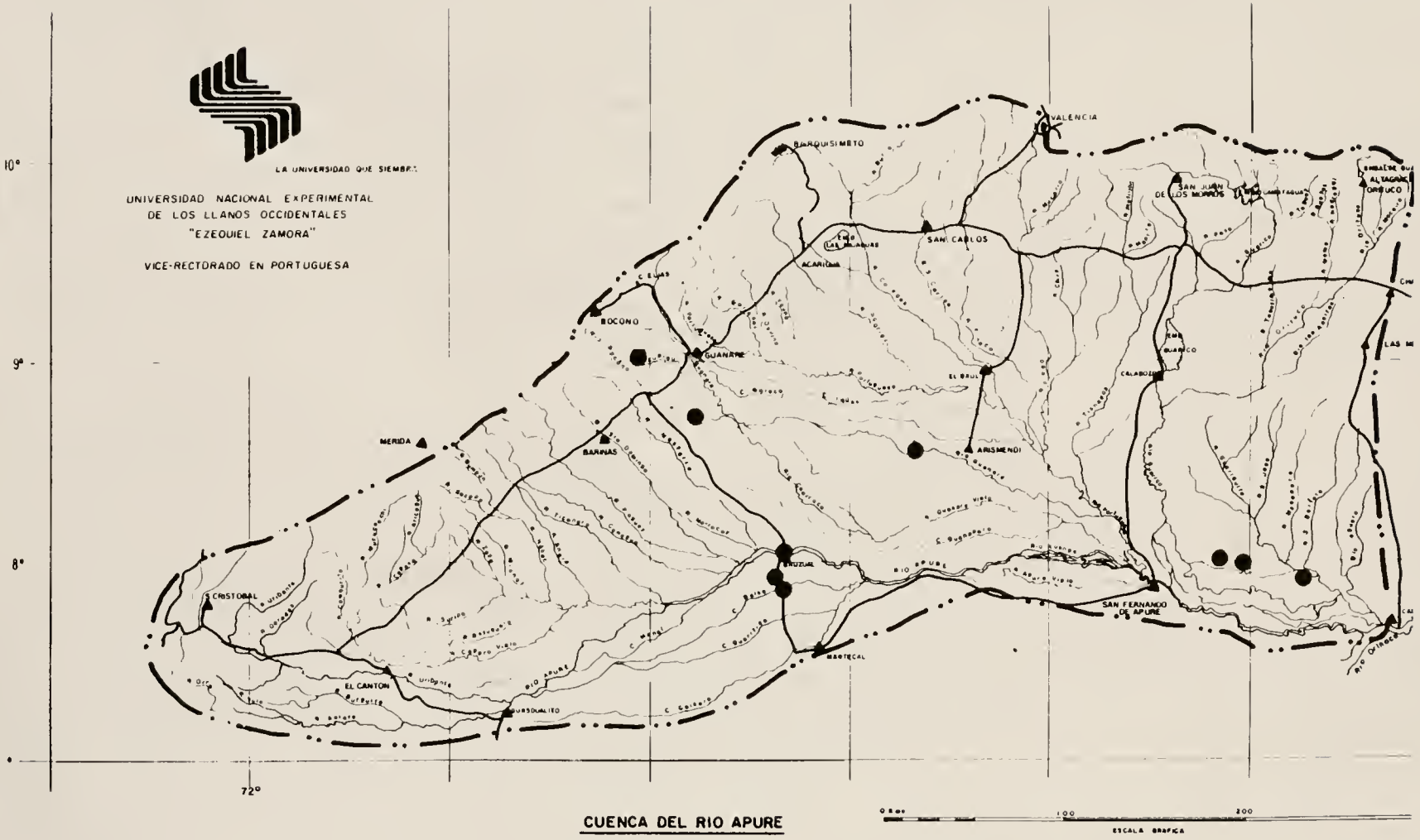
Food. OMNIVORE. This species feeds on fruits, seeds, flowers, aquatic vegetation, snails, insects and small fishes. Novoa et al. (1982) reported a seasonal change in its diet. He found it had a mostly vegetarian diet during the rainy season, and fed principally on a variety of fruits. In the dry season, it became more carnivorous and ate more insects and benthic invertebrates.

Reproduction. Strategy: r2. These fishes mature during the late dry season and reproduce with the first rains. Fecundity is high, with between 200,000 - 1,5000,000 eggs per female (Novoa et al. 1982).

Migrations. It moves upstream in large schools during the dry season to abandon the drying savanna streams and move into the main channel and up towards the highlands. It comes back down with the onset of the rains.

Importance. This is one of the most important food fish in the Apure drainage. It is highly appreciated by consumers, and usually on of the top 3-4 species in total weight sold in the commercial market.

Figure 195. Apure drainage distribution of *Piaractus brachypomus*.



CUENCA DEL RIO APURE

Poptella orbicularis (Valenciennes) 1849

Palometica - Silver Half-Dollar

Figs. 55 & 196. Map: fig. 197. Couplet 85a.

Generic synonymy

Poptella Eigenmann 1908:106 (type species: Tetragonopterus longipinnis Popta, by original designation).

Ephippicharax Fowler 1913a:51 (type species: Tetragonopterus compressus Günther, substitute name for Fowlerina).

Fowlerina (not of Pelseneer 1906 in Mollusca) Eigenmann 1907:771 (type species: Tetragonopterus compressus Günther, by original designation).

Specific synonymy

Tetragonopterus orbicularis Valenciennes in Cuvier & Valenciennes 1849:138 (type locality: Essequibo River, British Guiana).

Salmo sau-a Natterer in Kner 1859:174 (name in text).

Tetragonopterus compressus Günther 1864:319 (type locality: Essequibo, Surinam, Marañon).

Gymnocorymbus nemopterus Fowler 1914:248 (type locality: Rupununi River, British Guiana).

Fowlerina orbicularis Eigenmann 1910:441.

Ephippicharax orbicularis 1914:250 (Guyana); Eigenmann & Myers 1929:503 (Río Meta).

Ephippicharax orbicularis orbicularis Fowler 1950:367.

Poptella orbicularis Géry 1977:365-7, 454.

Etymology. POPTELLA = named to honor the naturalist Popta, the author of the species Tetragonopterus longipinnis, type species of the genus; ORBICULARIS = from the Latin "orbis" for disk, in reference to the round body shape.

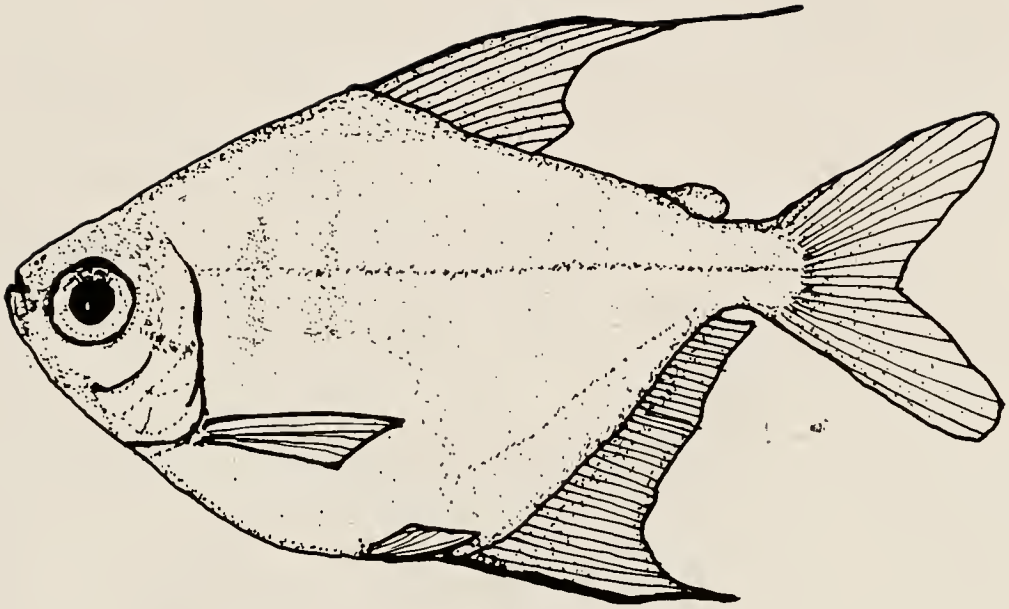


Figure 196. Poptella orbicularis.

Description

Illustrations. Fig. 55 & 196; Axelrod et al. 1971:F-486.10; Hoedeman 1975:688; Géry 1977:365, 366.

Diagnosis. This species has a predorsal spine embedded in the flesh just in front of the dorsal-fin origin. No other similar tetra in the Apure drainage has this structure. It is superficially similar to *Ctenobrycon spilurus*, but lacks the ctenoid scales typical of that species. Another look-alike, *Gymnocorymbus thayeri*, can be distinguished by having more lateral-line scales (about 37 vs about 32). Neither of the two species mentioned have the distinctive color pattern shown for *P. orbicularis* in fig. 55.

Size. It is reported to get quite large, Hoedemann (1975), reaching up to 120 mm in aquaria, however, the largest specimens taken during this study didn't reach half that size.

Morphology. This fish is deep-bodied, discoid, and highly compressed. A "saddle-shaped" predorsal spine is embedded in the flesh just anterior to the first dorsal rays.

Counts. AR 35-37; LLS 37.

Pigmentation. The body is silvery with a faint, often double humeral spot. The first anal-fin rays are black and usually elongated.

Distribution and Natural History

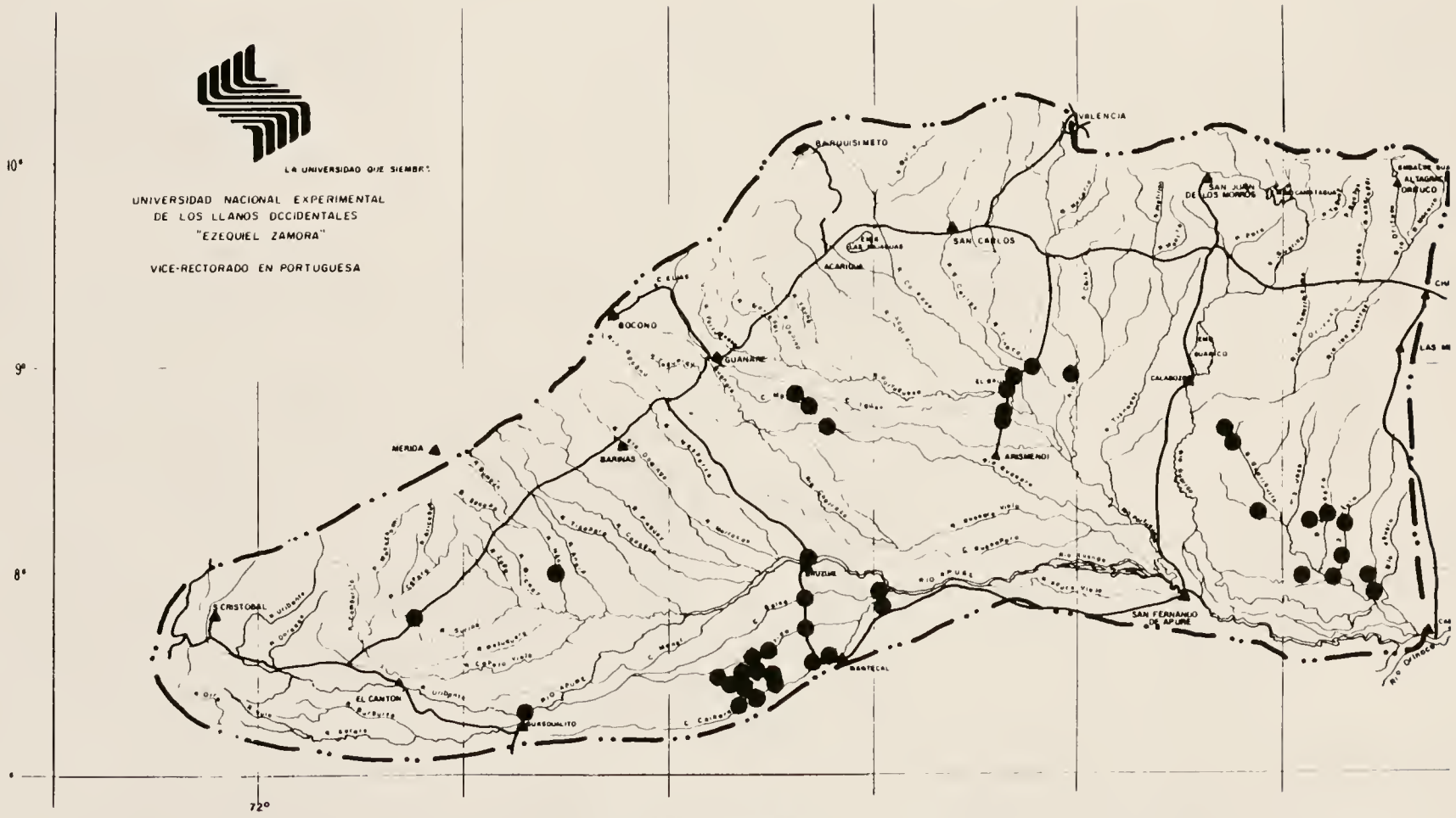
Range. It occurs in the Essequibo, Amazon and Orinoco basins.

Apure distribution. Map: fig. 197. This species is found in the low llanos.

Habitat. *P. orbicularis* is found both in lentic and lotic habitats, in white and black water, but is more common in the latter.

Abundance. COMMON.

Figure 197. Apure drainage distribution of *Poptella orbicularis*.



CUENCA DEL RIO APURE

Number of specimens examined. 3,662 from 108 collections.

Food. OMNIVORE. It feeds on seeds, spores, and microcrustaceans (K. Winemiller pers. com.).

Reproduction. Strategy: r1. This species spawns repeatedly throughout the rainy season. Females are larger, males have more intense black on their elongate first anal-fin rays. Eggs and sperm are scattered among aquatic vegetation and then abandoned (Hoedeman 1975).

Importance. This is an important ornamental species.

Pristobrycon striolatus (Steindachner) 1908

Caribe Palometa - Silver Dollar Piranha

Fig. 37 (caudal fin) & 198. Map: fig. 199. Couplet 28a.

Generic synonymy

Pristobrycon Eigenmann 1915:245 (type species: Serrasalmo (Pygocentrus) calmoni Steindachner 1908b, by original designation).

Specific synonymy

Serrasalmo (Pygocentrus) striolatus Steindachner 1908b:360 (type locality: Río Para).

Serrasalmus striolatus Norman 1928:794.

Serrasalmus (Pristobrycon) striolatus Géry 1977:279, 281, 283.

Pristobrycon striolatus Machado A. 1985:19; Nico & Taphorn 1988:311.

Pygocentrus striolatus Nico & Taphorn 1986:33

Comments. Piranha taxonomy is currently being revised by Dr. W. Fink & A. Machado A. Since available synonymies will undoubtedly undergo major revisions once their results are known, a greatly reduced list of references is given for this and the other species of piranhas in the Apure drainage (the genera Pygocentrus, and Serrasalmus).

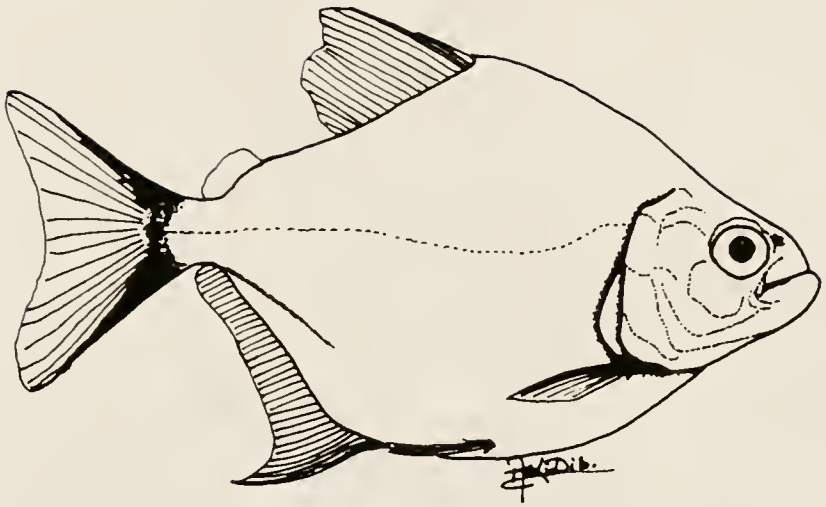


Figure 198. Pristobrycon striolatus.

Etymology. PRISTO = a saw, BRYCON = a genus of characid, hence a serrate "brycon," referring to the ventral serrae; STRIOLATUS = striated, from the Latin for furrow, marked with the light and dark bands present only in juveniles.

Description

Illustrations. Fig. 37 (caudal fin) & 198; Norman 1928:795; Myers 1972:111; Géry 1977:281; Nico & Taphorn 1986:33.

Diagnosis. This is the least pigmented of the piranhas. The body is silvery with only a few scattered irregular spots and there is no humeral spot. The caudal peduncle may have a faint black bar that extends out into the caudal fin along the outer rays (similar to the pigment pattern observed in S. irritans). There is a thin line of pigment along the base of the anal fin. The other fins are transparent. Its dentition is also characteristic. The teeth on the roof of the mouth are squared distally with rounded bases, and usually number fewer than five on either side. The last premaxillary tooth is about as wide as the tooth preceding it.

Size. It can reach about 260 mm SL.

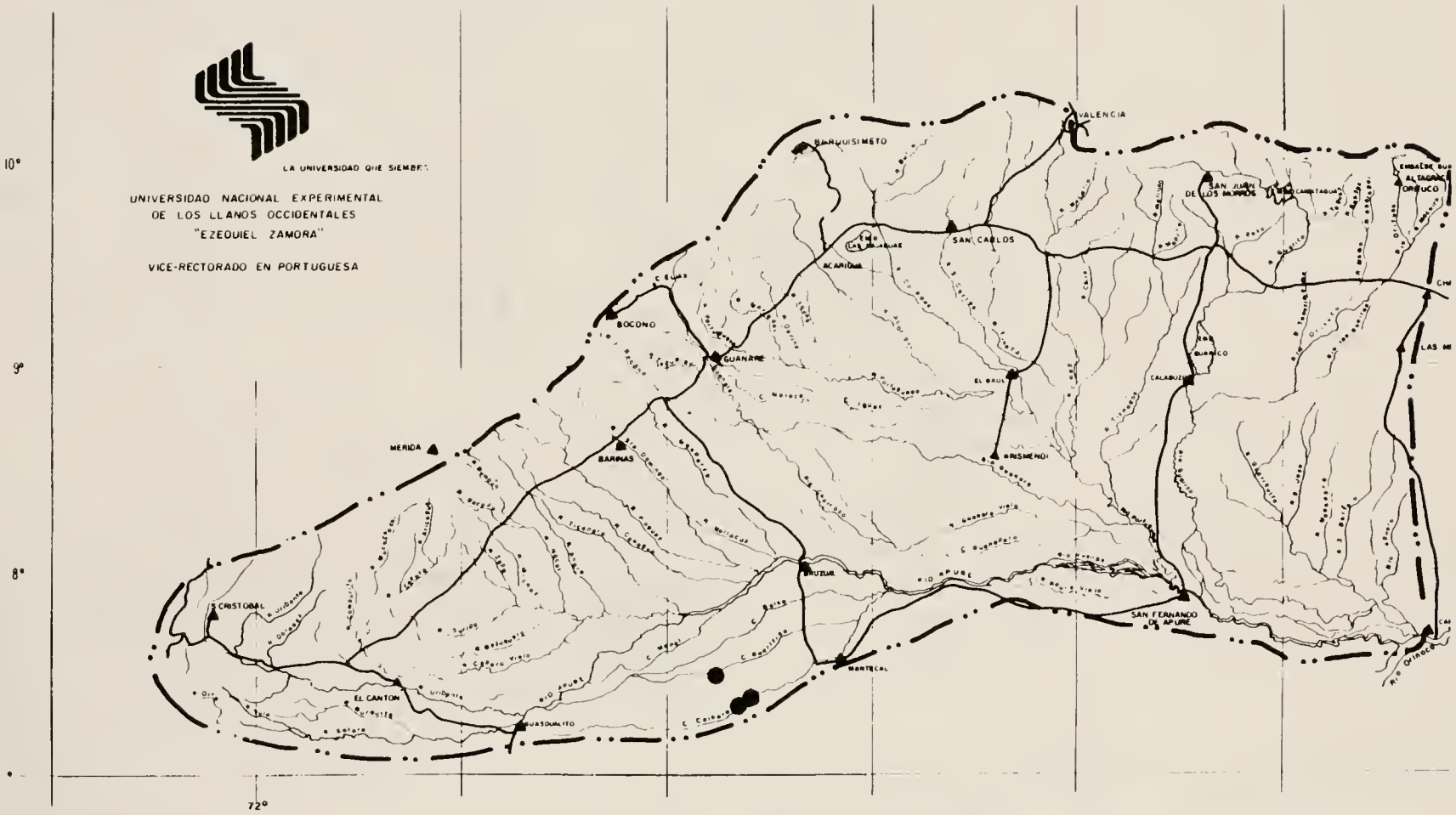
Morphology. The body is deep and fairly compressed. The snout is blunt, with its length shorter than the eye diameter. The dorsal profile is slightly concave above the eyes. The lower jaw projects slightly beyond the upper.

Counts. DR ii13-16; AR iii29-31; PR 13-14; teeth 6 on premaxilla, 7 on dentary, ventral serrae 20-23 before ventral fin origin + 9 after.

Measurements. GBD 61% SL; HL 3.3-3.4 in SL.

Pigmentation. See diagnosis. This fish is usually plain and silvery in life, but sometimes shows orange vertical bars on the sides. In preservative, the body sometimes shows irregular stripes or bars on the upper

Figure 199. Apure drainage distribution of *Pristobrycon striolatus*.



CUENCA DEL RIO APURE

sides and the operculum has a dark blotch. The base of the caudal fin is black.

Distribution and Natural History

Range. It occurs in Guyana, and in the Orinoco and Amazon basins.

Apure distribution. Map: fig. 199. This species has been found only in northern Apure state, west of Mantecal.

Habitat. It lives in blackwater llaneran streams.

Abundance. UNCOMMON.

Number of specimens examined. 40 from 12 collections.

Food. CARNIVORE. Small juveniles start life as planktivores, taking copepods, cladocerans, diptera larvae and fish scales. They later switch to fish fins scales and flesh, seeds, shrimp, aquatic beetles and other aquatic invertebrates as main items in their diet (Machado A. & García 1986; Nico & Taphorn 1986, 1988).

Reproduction. Strategy: r2. It is probably an egg scatterer that synchronizes reproduction with the onset of the rainy season in May to June.

Pygocentrus caribe Valenciennes 1849

Caribe Pechirojo, Colorado or Capaburro - Red-Bellied Piranha

Fig. 200. Map: fig. 201. Couplet 22a.

Generic synonymy

Pygocentrus Müller & Troschel 1844:94 (type species: Serrasalmo piraya Cuvier, by subsequent designation of Eigenmann 1910:442).

Gastropristis Eigenmann 1915:238 (type species: Serrasalmo (Pygocentrus) ternetzii Steindachner, by original designation).

Rooseveltiella (not of Fox 1914 in Siphonaptera) Eigenmann 1915:240 (type species: Pygocentrus nattereri Kner, by original designation).

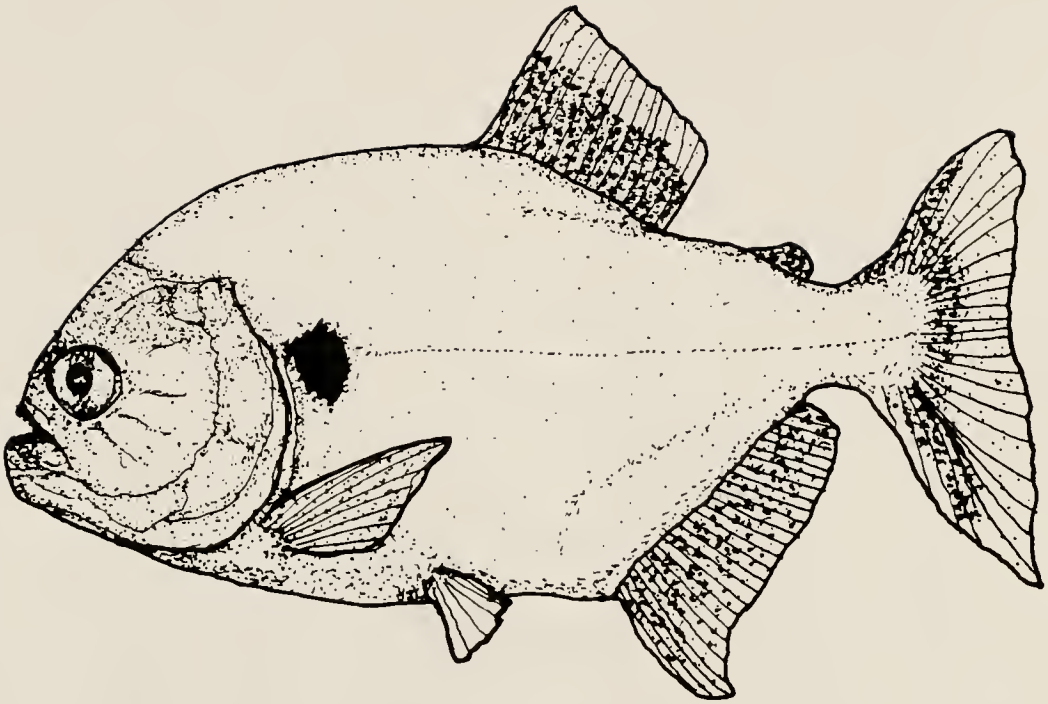


Figure 200. Pygocentrus caribe.

Specific synonymy

Serrasalmus caribe Valenciennes 1849:278 in Cuvier & Valenciennes 1849 (type locality: Río Orinoco, Río Apure, Llanos of Venezuela); Eigenmann & Eigenmann 1891:60; Norman 1928:803; Schultz 1944b:255.

Serrasalmo (Pygocentrus) notatus Lütken 1874:238 (type locality: Caracas, Venezuela), not seen.

Serrasalmo nattereri Peters 1877:472 (San Fernando de Apure, Venez.) Röhl 1942:377 (Orinoco).

Pygocentrus notatus Eigenmann & Eigenmann 1891:60 (Venez.); Taphorn & Lilyestrom 1984:70 (biology) Machado A. & García 1986:193 (diet); Nico & Taphorn 1986:24 (diet); Nico & Taphorn 1988:311.

Pygocentrus stigmaterythraeus Fowler 1911:424 (type locality: La Pedrita on Caño Uracoa, Venez.).

Rooseveltiella stigmaterythraeus Eigenmann 1915:245.

Serrasalmus notatus Norman 1928:788, fig.5. (as junior synonym of S. nattereri).

Serrasalmus nattereri Schultz 1944b:254.

Serrasalmus (Taddyella) notatus Géry 1977:291

Comments. According to Drs. W. Fink and A. Machado Allison, who are currently revising the serrasalmines (pers. com.), the correct name of the most common piranha in the Apure drainage is P. caribe . This fish has usually been identified in previous literature as Pygocentrus notatus.

Etymology. The etymology of this generic name remains unclear, perhaps PYGO is from the Greek "pygidion" for rump or caudal, or possibly from the Latin "pygmaeus" for pygmy or small, CENTRUS = central, middle; CARIBE = the local Venezuelan name for piranha.

Description

Illustrations. Fig. 200; as P. notatus: Norman 1928:788 (drawing of holotype); Mago L. 1978:21; Novoa et al. 1982: fig. 8; Machado A. 1982:fig. 5 (juvenile); Román 1985:103; Nico & Taphorn 1986:24.

Diagnosis. This species is easily recognized in its normal adult coloration of a steel-blue dorsum and sides, bright scarlet-red belly, and large jet-black humeral spot. It is further characterized by having asymmetrically tri- or pentacuspid teeth that are set so close to one another as to form a single, jagged cutting edge (so much so that the teeth on either side of one jaw are replaced as a set, not individually). There are no teeth on the roof of mouth. The anal-fin rays number 29 or fewer.

Size. Novoa et al. (1982) reported specimens that reached 480 mm TL. One of the largest specimens from this study, measured 315 mm SL, and weighed 1 kg.

Morphology. The body is thick, heavy-set and somewhat discoid. The snout is quite blunt and short, the lower jaw is massive and projects far beyond the upper.

Counts. DR ii15-17; AR 26-29.

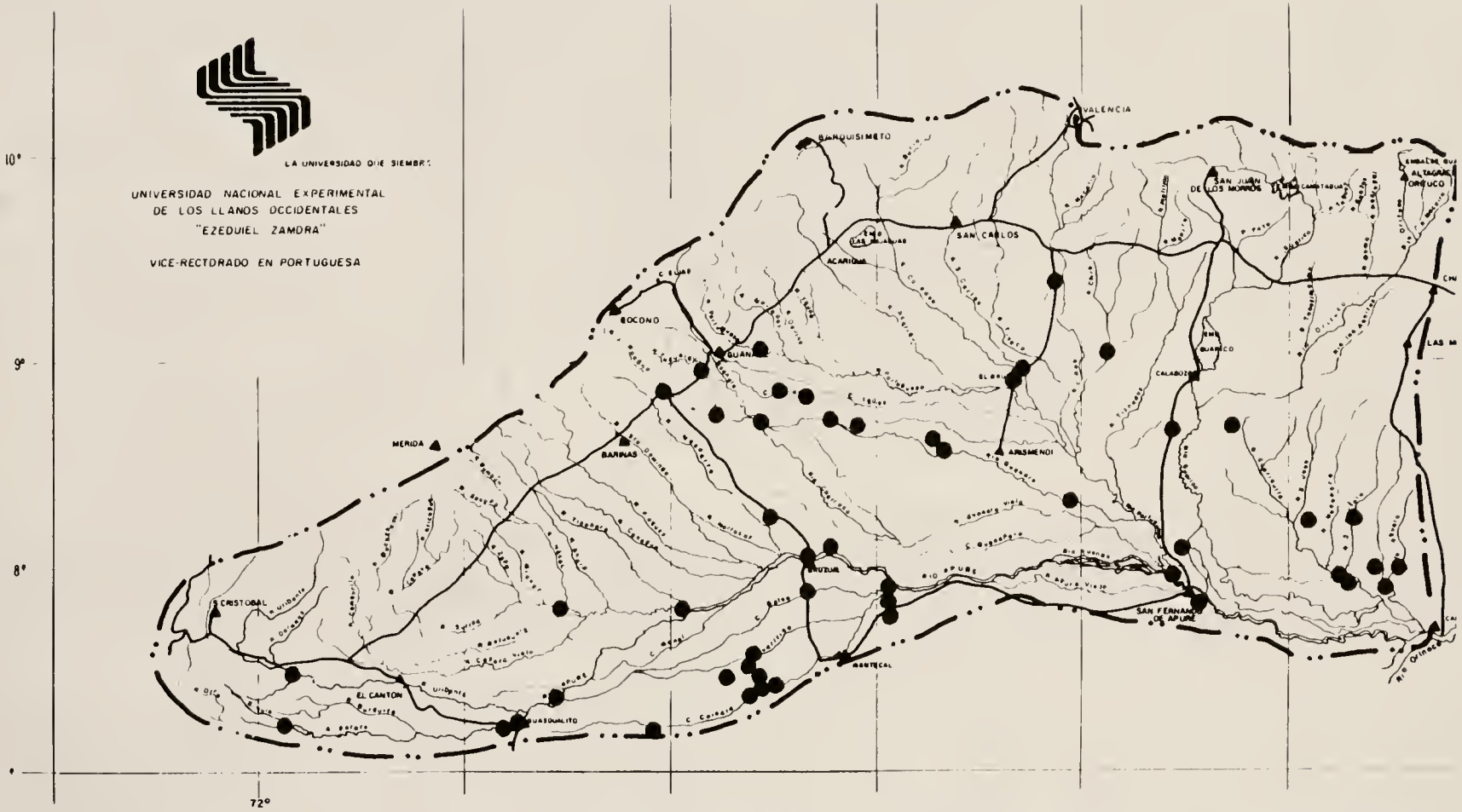
Pigmentation. The dorsum is steel-blue, olive-green or gray. The sides are similarly colored but more silvery. The abdomen, and the pectoral, anal and pelvic fins are bright scarlet red. A distinctive, large black humeral blotch is present just behind the opercle. Adults in breeding color are black with purple and gold flecks on the dorsum and sides.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 201. It is very common in lowland llanos, but extends up to the piedmont.

Figure 201. Apure drainage distribution of *Pygocentrus caribe*.



CUENCA DEL RIO APURE

Habitat. It lives in all types of water both lentic and lotic, in the llanos and piedmont.

Abundance. COMMON. This is the most widespread species of piranha in the Apure drainage.

Number of specimens examined 1,136 from 174 collections.

Food. CARNIVORE. The smallest juveniles (10-19 mm SL) feed on microcrustaceans and gradually switch to small aquatic insects. Cladocerans, chironomid larvae, copepods, ostracods and Ephemeroptera make up the diet at these smallest sizes. Unlike most other piranha species, fish fins and scales are of minor importance for larger juveniles. As they increase in size they take larger aquatic insects and then switch to fish flesh as the major element of their diet for the rest of their lives. Adults feed mostly on whole small fishes and the fins of larger fishes. They also eat small vertebrates such as birds, lizards, and mice (K. Winemiller pers. com.); Machado A. & García 1986; Nico & Taphorn 1986, 1988).

Reproduction. Strategy: r2. The parental protection of the nest site that is exhibited by this species led us to classify it as a K strategist in an earlier report (Winemiller & Taphorn 1989). However, its high fecundity and single reproductive bout per year seem more in accord with r2 strategists. This species' apparent intermediate nature merely serves to point out the continuous nature of the life history strategy scheme we proposed. Most species' life history strategies are a compromise between the different selective pressures brought to bear. Sexual maturity is usually reached by the age of 12 months. Gonads begin to mature in this species 1-2 months before the onset of the rains. Reproduction is annual and usually occurs during the first three months of the rainy season, when most individuals of reproductive age participate in a massive spawning

bout. Fecundity is high, between 3048 (Winemiller & Taphorn 1989) in small females to 20,000 eggs in the largest (González Y. 1980). Eggs are relatively large, about 1.5 mm in diameter.

The nearly identical Brazilian species, P. nattereri, has been bred in captivity (Azuma 1975, Brandy & Campbell 1984). Those authors always found the eggs in the early morning hours, and were usually guarded by one of the parents. The eggs were pale orange, about 1/16" in diameter, and had been scattered over an area of 1-1.5 square feet. Surprisingly for a species with parental care, the eggs were reported not to be adhesive. The eggs hatched within 48-72 hours and the yolk sac was absorbed in another 48-72 hours. The relatively large fry were able to feed immediately on brine shrimp nauplii.

P. caribe is often observed lingering in the shallows, among aquatic vegetation during the breeding season. The males are probably territorial at this time. They probably make nests by hollowing out a sphere amidst the aquatic plants.

Migrations. Apparently this species migrates with the change of the seasons, downstream at the beginning of the wet season and upstream at the beginning of the dry season, but little hard data supports this supposition.

Importance. This species is potentially dangerous to man, but its "bloodthirstiness" is highly exaggerated. Most reports of "attacks" on man are probably better explained by scavenging on cadavers of drowning victims. Piranhas are eaten in some regions, but were not a commercial species until recently, in response to dwindlinmg stocks of the more desirable fishes. Many people refuse to eat them because of their supposed anthropophagous habits.

Pygopristis denticulatus (Cuvier) 1819

Caribe Palometa - Silver Dollar Piranha

Figs. 34a (teeth) & 202. Map: fig. 203. Couplet 21a.

Generic synonymy

Pygopristis Müller & Troschel 1844:95 (type species: Pygopristis fumarius Müller & Troschel 1844 = Serrasalmus denticulatus [Cuvier] 1819, by subsequent designation of Eigenmann 1910); Müller & Troschel 1845:pl. 9, fig. 2a & b.

Specific synonymy

Serrasalmo denticulatus Cuvier 1819:371 (type locality: uncertain); Günther 1864:367 (British Guiana).

Pygopristis denticulatus Müller & Troschel 1844:95; 1848:637; Valenciennes in Cuvier & Valenciennes 1849:297; Mago L. 1970:73.

?Pygopristis antoni Fernández Y. 1965:1 (type locality: Río San José, Guárico state, Venez.); Mago L. 1970:73.

Serrasalmus (Pygopristis) denticulatus Géry 1972:209 (key); 1977:278-80 (key).

Serrasalmus (Pygopristis) antoni Román 1985:111 (Venez.).

Comments. P. antoni Fernández Y. 1965, was described from the Apure River drainage, Río San José, Guárico state. Géry (1977) stated that the species described by Fernández Y. (P. antoni) is more like a Pristobrycon, but he had not examined any specimens. Fernández Y. described the teeth of his specimens as follows: "The teeth of this species are tricuspid but definitely not of the angular type of Serrasalmus and Pygocentrus. They are of the Pygopristis type and their cusps are short, shorter than the width of their base, which is ellipsoid in cross section. The edges of the cusps are rounded, not straight, like certain teeth of the Cheirodontids. The third

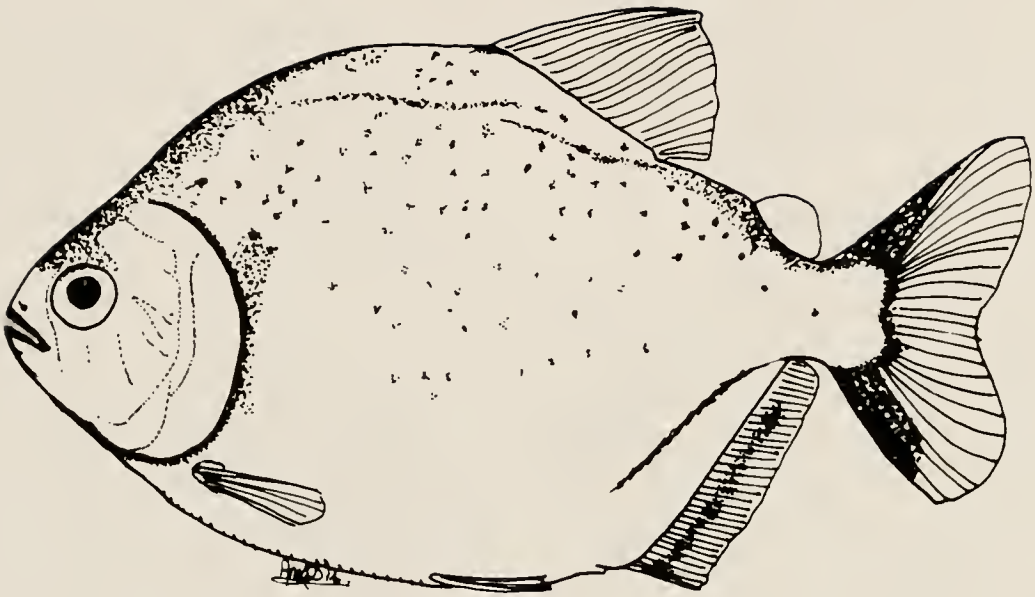


Figure 202. Pygopristis denticulatus.

intermaxillary tooth is the shortest, almost typical of the fishes of the Serrasalmidae group. The mandibular (dentary) teeth are separated at their bases and do not form a continuous border as in Serrasalmus" (my translation). He also stated that the first and sixth intermaxillary (meaning premaxillary ?) teeth are bicuspid in P. antoni, but quadricuspid and pentacuspid in P. denticulatus. I have compared specimens from the Aguaro River with some from the Amazonas territory, and found them to be nearly identical, but I have not seen material from Guyana, the supposed type locality for P. denticulatus. For now, I consider P. antoni to be a junior synonym of P. denticulatus, but to be certain Guyanan material must be compared with the Orinoco specimens.

Etymology. PYGO = "pygmaeus," Latin for small, PRISTIS = saw, from the Greek; DENTICULATUS = probably refers to the multicuspid teeth.

Description

Illustrations. Figs. 34a (teeth) & 202; Myers 1972:113; Géry 1977:280; Román 1985:111 (as Serrasalmus P. antoni).

Diagnosis. This fish looks like a cross between a Metynnis with a Serrasalmus. The roof of the mouth lacks teeth. The jaws are relatively weakly developed for a piranha, with incisor-like teeth that are symmetrical, at least pentacuspid, and not specialized for tearing flesh as in Serrasalmus species. The anal fin is bilobed in males. Unlike most other piranhas, which have completely scaled anal fins, this species has at most two rows of scales on the anal-fin base.

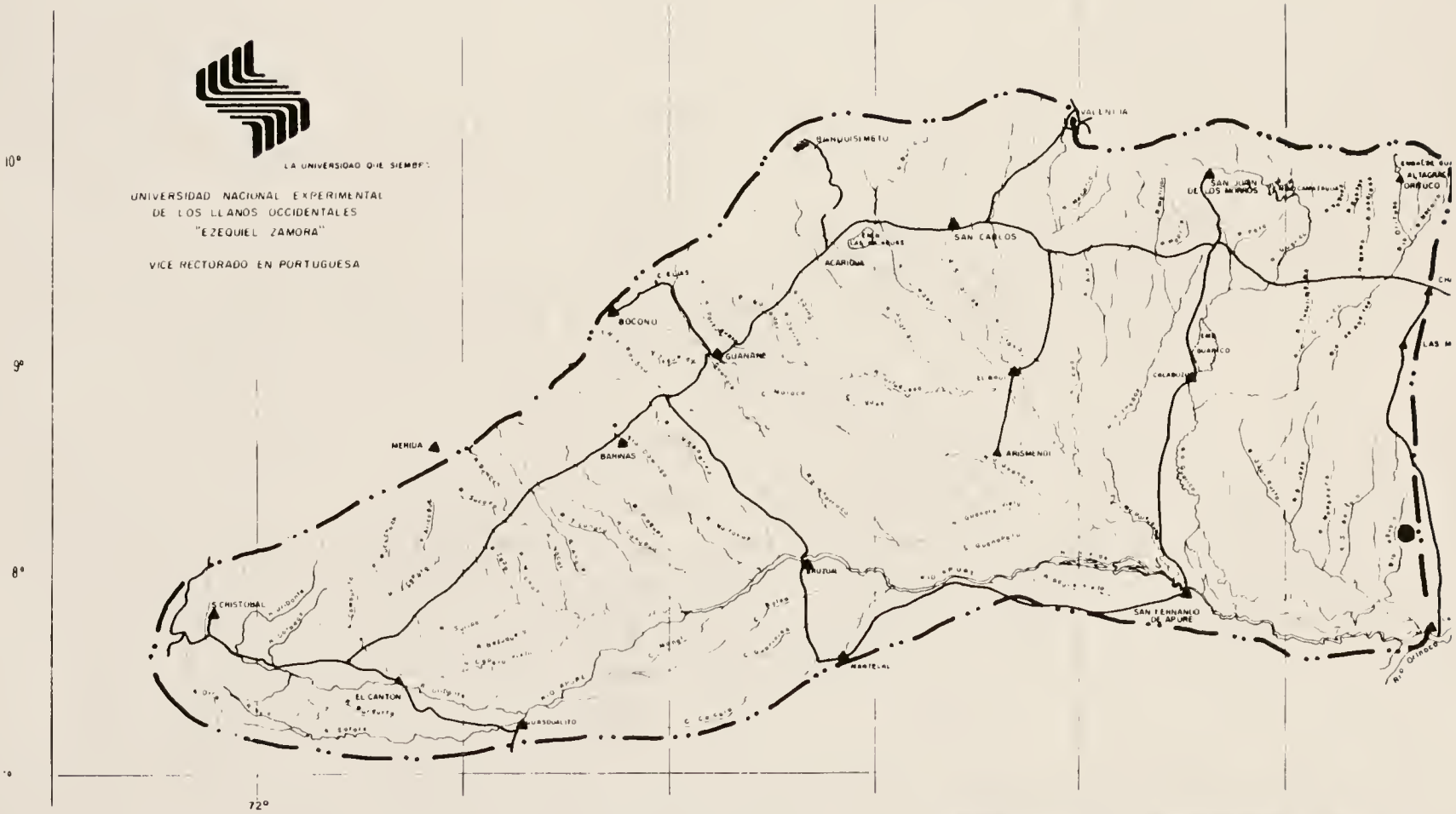
Size. It can grow to about 150 mm SL.

Morphology. The body is discoid.

Counts. DR ii17-19.

Pigmentation. The dorsum is silvery, the ventrum red, and the base of the caudal fin black. The anal, pelvic and pectoral fins are reddish.

Figure 203. Apure drainage distribution of *Pygopristis denticulatus*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in the Guyana and the Orinoco Basin.

Apure distribution. Map: fig. 203. It is so far known only from the Aguaro River system.

Habitat. It lives mainly in blackwater streams.

Abundance. RARE.

Number of specimens examined. 4 from 1 collection.

Food. OMNIVORE. It probably feeds on small aquatic animals, seeds, and fruits etc.

Reproduction. Strategy: r2. It is probably an egg scatterer that synchronizes reproduction with the onset of the rains in May or June.

Importance. Ornamental.

Roeboides affinis (Günther) 1868

Dientoncito

Figs. 29a (head) & 204. Map: fig. 205. Couplet 8a.

Generic synonymy

Roeboides Günther 1864:333 (type species: Epicyrtus microlepis Reinhardt, by subsequent designation of Eigenmann 1910:445); Jordan 1919:333 (designated as logotype Anacyrtus guatemalensis Günther [later invalidated]).

Rhoeboides Berg 1899:94 (type species: Epicyrtus microlepis Reinhardt).

Cynocharax Fowler 1906 (1907):457 (type species: Anacyrtus affinis Günther, by original designation).

Specific synonymy

Anacyrtus affinis Günther 1868:481 (type locality: Río Huallaga, Alto Amazonas), seen; Peters 1877:472 (Calabozo, Venez.).

Cynopotamus affinis Garman 1890:12.

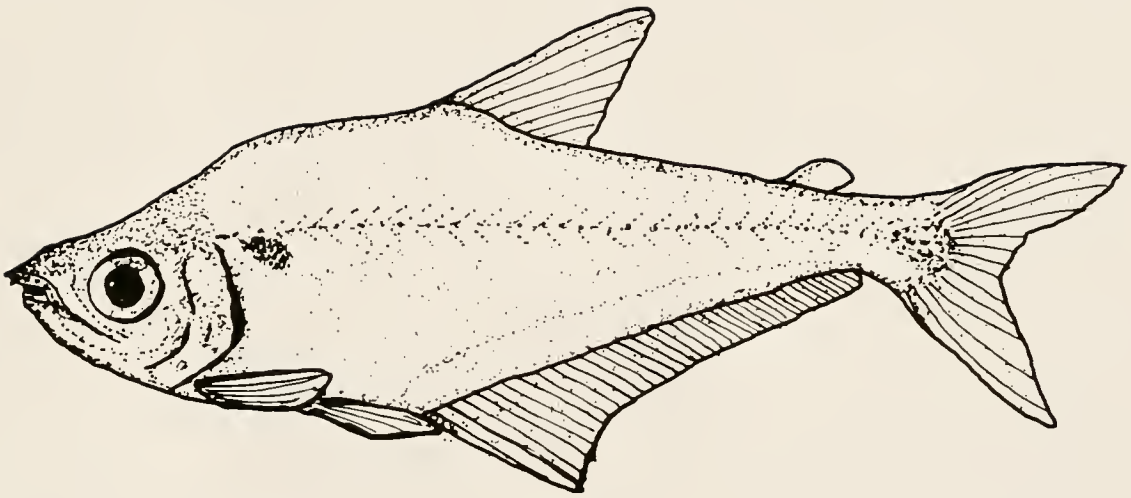


Figure 204. Roeboides affinis.

Roeboides affinis Fowler 1905 (1907):457; 1939:269; 1943:100; 1945:163. Eigenmann 1910:445; Eigenmann & Allen 1942:258 (Orinoco); Mago L. 1970:73.

Roeboides rubrivertex Cope 1872:265 (292) (type locality: between the mouths of the Río Negro and the Río Ucayali).

Comments. Pellegrin (1899) cited Anacyrtus microlepis (Reinhardt) 1849 from the Apure River, but that species has over 110 lateral scales, so the reference is probably a misidentification of one of the other cynopotamines, perhaps of Cynopotamus or Charax. Schultz copied the error (1944b). Román (1985) misidentified Charax gibbosus as Roeboides microlepis.

Etymology. ROEBOIDES = probably from the Greek "rhomboeides" which means "resembling a rhombus," in reference to the humped back of these fishes; AFFINIS = related to, or like.

Description

Illustrations. Figs. 29a (head) & 204; Román 1985:160.

Diagnosis. In the Apure drainage, only Roeboides, Exodon and Serrabrycon species have "tusks" or everted teeth, which are used to scrape scales from other fishes. Exodon paradoxus is easily recognized by its pigmentation pattern (fig. 32). Serrabrycon magoi has only 18 anal-fin rays versus over 45 in R. affinis. R. dayi has smaller "tusks" than R. affinis, and differs further in having the humeral spot placed much farther back on the body (nearer a vertical through the dorsal-fin origin than the opercle). R. affinis also has more lateral-line scales than R. dayi (69-75 vs 55-61). Small specimens of Roeboides are superficially similar to Charax and Cynopotamus. Upon closer inspection with magnification, small "tusks" can usually be seen, even in very small Roeboides.

Size. It grows to about 70 mm SL.

Morphology. The humpbacked profile of this fish is characteristic. The upper jaw extends well beyond the lower. The "tusks" are obvious and well developed.

Counts. AR 47-53; LLS 69-75.

Pigmentation. This fish is nearly transparent in life, but turns white in preservative. It has a faint humeral spot, and sometimes a faint caudal spot as well.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 205. It is common in the lower llanos.

Habitat. *R. affinis* lives in slower-moving lowland streams and in ponds.

Abundance. COMMON.

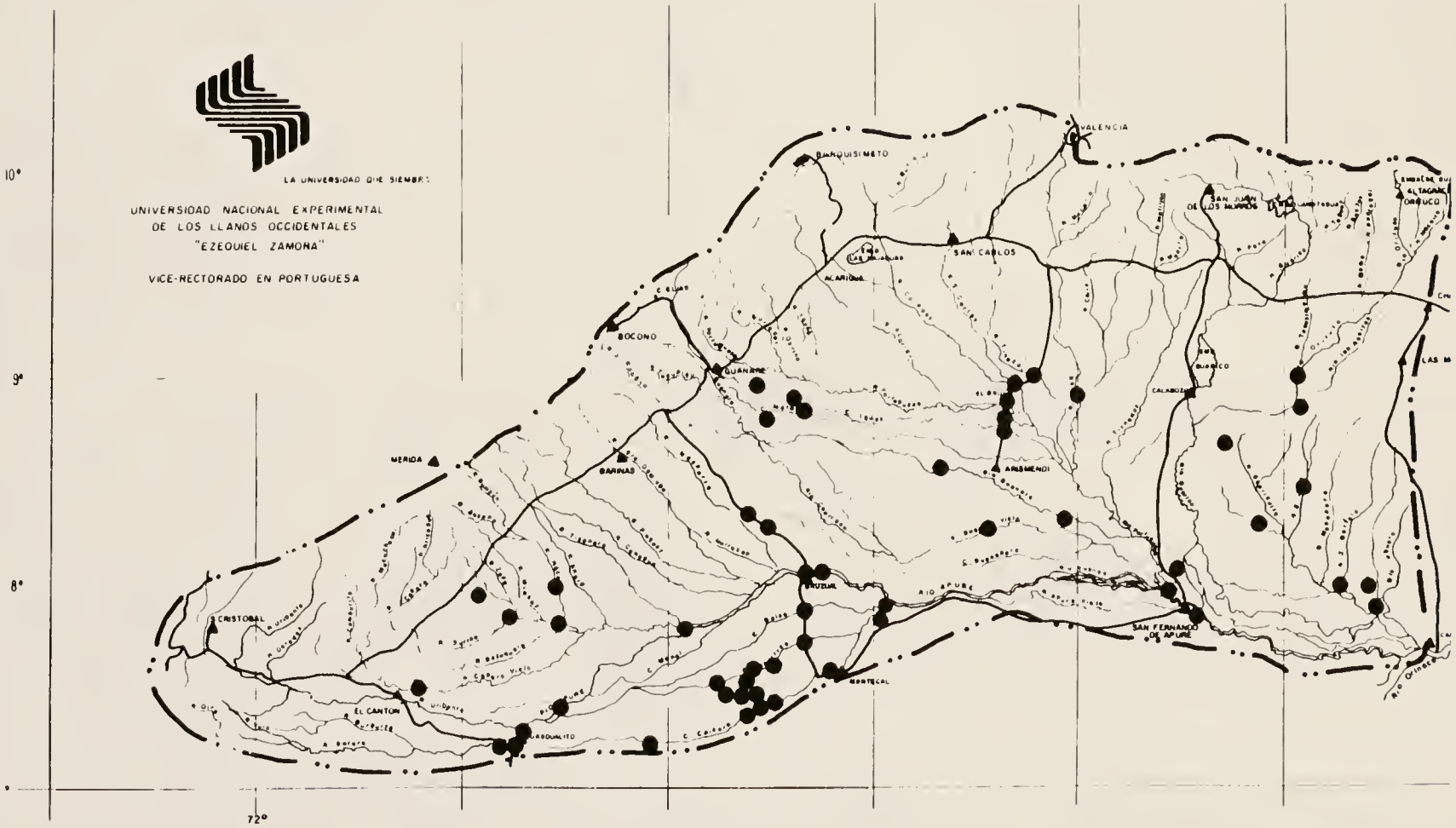
Number of specimens examined. 826 from 111 collections.

Food. CARNIVORE. This species employs a highly specialized feeding adaptation, the "tusks," to scrape scales from the sides of other fishes. It also includes small aquatic invertebrates and fishes in its diet. It stalks prey in a head-down position, slowly advancing towards its victim in a head on position, until it reaches striking distance.

Reproduction. Strategy: r1; fecundity: between 100-750 eggs/ovary; this egg scatterer breeds all year round, with a peak in reproduction between February and June (Winemiller & Taphorn 1989).

Importance. This transparent fish is sometimes sold as the "glass headstander" in the aquarium trade, but its feeding habits quickly make it unpopular with most aquarists.

Figure 205. Apure drainage distribution of *Roeboides affinis*.



CUENCA DEL RIO APURE

Roeboides dayi (Steindachner) 1878

Dientoncito - Scale-Eating Glassfish

Figs. 29b & 206. Map: fig. 207. Couplet 8b.

Specific synonymy

Anacyrtus (Rhaeboides) dayi Steindachner 1878:61 (type locality: Magdalena Basin, northern Colombia), seen.

Roeboides dayii Eigenmann 1920:12 (Lake Valencia Basin).

Roeboides dayi dayi Schultz 1944b:304; Mago L. 1970: lists.

Roeboides dayi Géry 1977:(key, range).

Comments. Schultz (1944b) described the subspecies R. dayi dientonito from the Venezuelan Maracaibo Basin. It supposedly has fewer lateral-line scales. However, his sample size was not very large, and the affinities of the Maracaibo Basin are strongest with the ichthyofauna of the Magdalena Basin in Colombia, the type locality of R. dayi dayi Steindachner. Apure drainage specimens might be expected to diverge even more. It was premature to introduce trinomials into South American fish nomenclature in 1944b, and still is today in most cases.

Etymology. DAYI = Though I have no direct evidence, this species might have been named for Benjamin Henry Day (1810-1889) an American journalist who published the New York Sun.

Description

Illustrations. Figs. 29b (head) & 206.

Diagnosis. See diagnosis for R. affinis. The upper jaw is about as long as the lower. The "tusks" are present, but are not as prominent as in R. affinis, and in small specimens are often hard to see.

Size. It grows to about 60 mm SL.

Counts. AR 50-53 (N=5); LLS 55-61 (N=6).

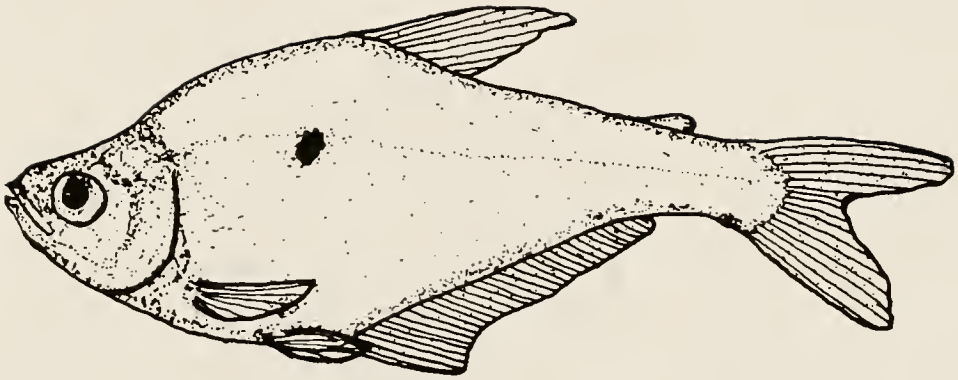
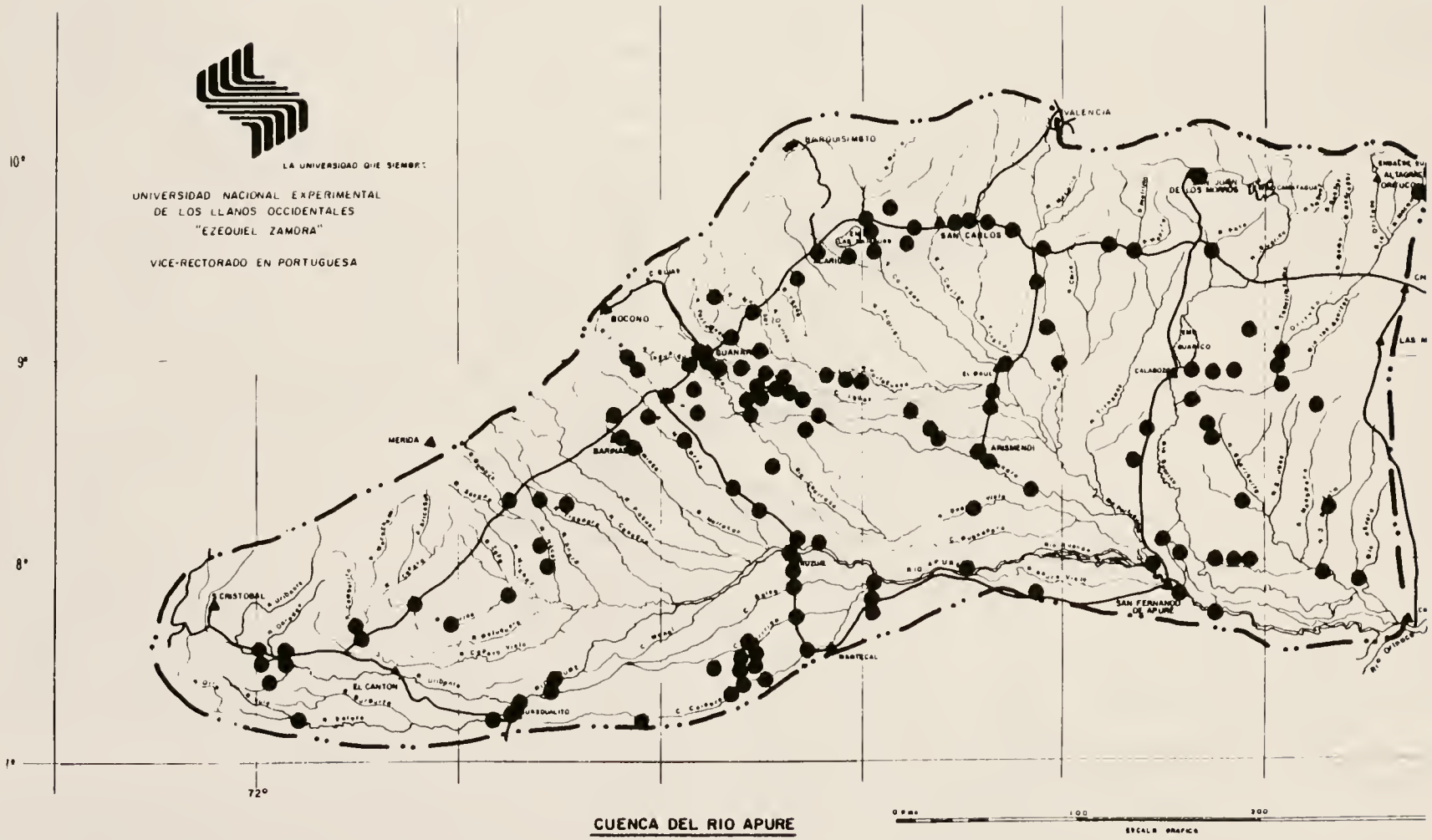


Figure 206. Roeboides dayi.

Figure 207. Apure drainage distribution of *Roeboides dayi*.



CUENCA DEL RIO APURE

Pigmentation. It is transparent in life with a black humeral spot, but turns white in preservative.

Distribution and Natural History

Range. It occurs in Venezuela, Trinidad and Colombia.

Apure distribution. Map: fig. 207. This species is very widespread throughout the piedmont and llanos.

Habitat. This fish is most common in lentic habitats, such as the slower-moving sections of streams and rivers, as well as in ponds and swamps, bajios and esteros.

Abundance. ABUNDANT.

Number of specimens examined. 8,067 from 279 collections.

Food. CARNIVORE. It feeds on the scales of other fishes, and aquatic insects, especially Ephemeroptera (K. Winemiller, pers. com.).

Reproduction. Strategy: rl. This species reaches sexual maturity quickly (about 3 months). Individuals can breed at least twice a year, but reproduction occurs in all months. It is probably an egg scatterer.

Importance. Ornamental.

Salminus hilarii Valenciennes 1849

Dorado, Saltador - South American Salmon

Fig. 208. Map: fig. 209. Couplet 49a.

Generic synonymy

Salminus Agassiz in Spix 1829:76 (type species: Hydrocyon brevidens Valenciennes, by monotypy, (not Hydrocyon brevidens Cuvier) = Salminus maxillosus Valenciennes); Müller & Troschel 1845:16.

Specific synonymy

Salminus hilarii Valenciennes in Cuvier & Valenciennes 1849:64 (type locality: Río Sâo Francisco); Pellegrin 1899:157 (Apure River, Venez.)

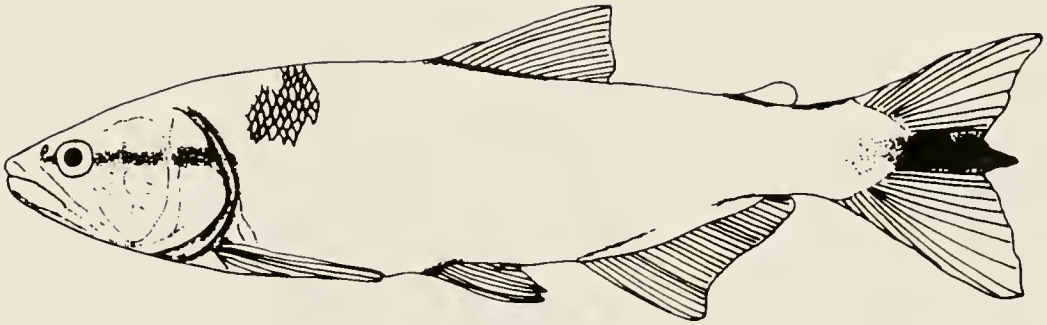


Figure 208. Salminus hilarii.

Schultz 1944b:293 (Aragua state, Venez.) Mago L. 1970:73; Géry 1977:331, 334.

Comments. This species is difficult to distinguish from S. affinis Steindachner, with which it is supposedly sympatric. Restricted as they are to montane headwaters, it is hard to understand how a northern South American species of Salminus could be the same as that in the Río Sâo Francisco of Paraguay and southern Brazil. Despite the popularity of these fishes as sport and food fish, little has been done on their taxonomy.

Etymology. SALMINUS = like a salmon. HILARII = meaning unknown.

Description

Illustrations. Fig. 208; Géry 1977:331.

Diagnosis. There are two rows of conical teeth on both jaws, but none are canines that stand out above the rest. The maxilla is almost completely toothed. S. hilarii might be confused with small Brycon whitei but the latter differs significantly in dentition, has a much deeper body, a shorter, more rounded snout, and more lateral-line scales (66-70 vs 55-65).

Size. It is usually taken at 400-500 mm SL, but are said to reach nearly a meter.

Morphology. This fish is salmon-shaped with an elongate, fusiform body that is little compressed. The lateral-line is complete.

Counts. DR 11; AR 24-26; LLS about 60-72; TS 10 above LL.

Pigmentation. Live fish are spectacularly colorful, with bright orange spots along the sides mixed with blue, yellow and black.

Distribution and Natural History

Range. Though exact boundaries are still uncertain, its range at least includes the Andean streams of the Orinoco Basin in Colombia

and Venezuela. This species has been cited from the Andes as far south as Bolivia, but those reports are probably based on another species.

Apure distribution. Map: fig. 209. The map reflects more about fishing efforts with hook and line, rather than the actual distribution of this species. The Saltador is almost never caught with seines, our most usual mode of collecting. It is restricted to mountain and piedmont streams as a rule, though the collection from Bruzual, on the banks of the Apure River itself, indicates that it can survive in the lowlands, at least for a while. The specimen in question is a juvenile that probably washed downstream during the torrential rains typical of the wet season in the Apure drainage.

Habitat. It is usually seen in montane rivers with strong, fast currents. It prefers streams with clear, clean water that runs over rocky substrates. For a fish of this size, it inhabits relatively shallow mountain river reaches with typical depths of 40 cm.

Abundance. UNCOMMON. The scarcity of specimens reflects more their ability to avoid capture, rather than actual rarity. We sampled infrequently in the usually inaccessible mountain streams and rivers where this species lives.

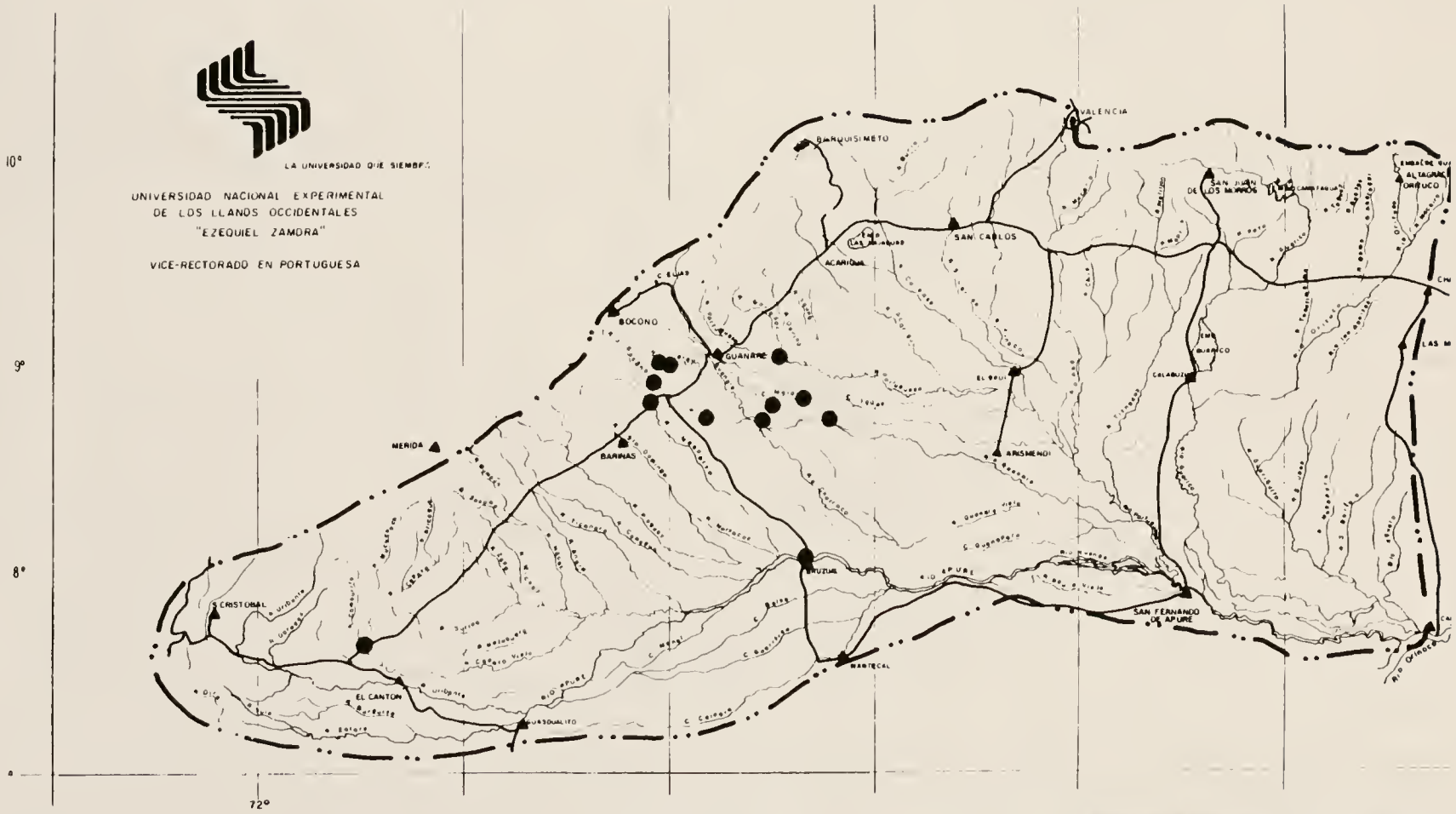
Number of specimens examined. 26 from 15 collections.

Food. CARNIVORE. Piscivore. This species is usually seen in groups, frequently in mixed shoals with *Brycon whitei*, patrolling the pools just below rapids for potential prey. It will readily take a silver spoon offered by anglers.

Reproduction. Strategy: r2. It is probably an egg scatterer that synchronizes reproduction with the onset of the rains in May to June.

Migrations. It is known to migrate annually for great distances. The Apure populations move upstream in the dry season.

Figure 209. Apure drainage distribution of *Salminus hilarii*.



CUENCA DEL RIO APURE

Importance. This is a magnificent and highly valued sport fish.

Serrabrycon magoi Vari 1986

Sardinita - Scale-Eating Tetra

Fig. 211. Map: fig. 212. Couplet 13b.

Generic synonymy

Serrabrycon Vari 1986:329 (type species: Serrabrycon magoi Vari 1986, by original designation).

Specific synonymy

Serrabrycon magoi Vari 1986: 329 (type locality: Venezuela, Territorio Federal Amazonas, Departamento Río Negro, lower portion of Caño Manu, which drains into the Río Casiquiare about 250 m upstream of Solano, approx. 02° 00' N, 66° 57' W), seen.

Comments. This species was recently described from the Amazon Territory of Venezuela. Its presence in the blackwater streams of the Apure drainage point to a link between these two faunas.

Etymology. SERRA = saw, from the Latin, BRYCON = a genus of characid; MAGOI after Dr. Francisco Mago Léccia, eminent Venezuelan ichthyologist.

Description

Illustrations. Fig. 211; Vari 1986:330.

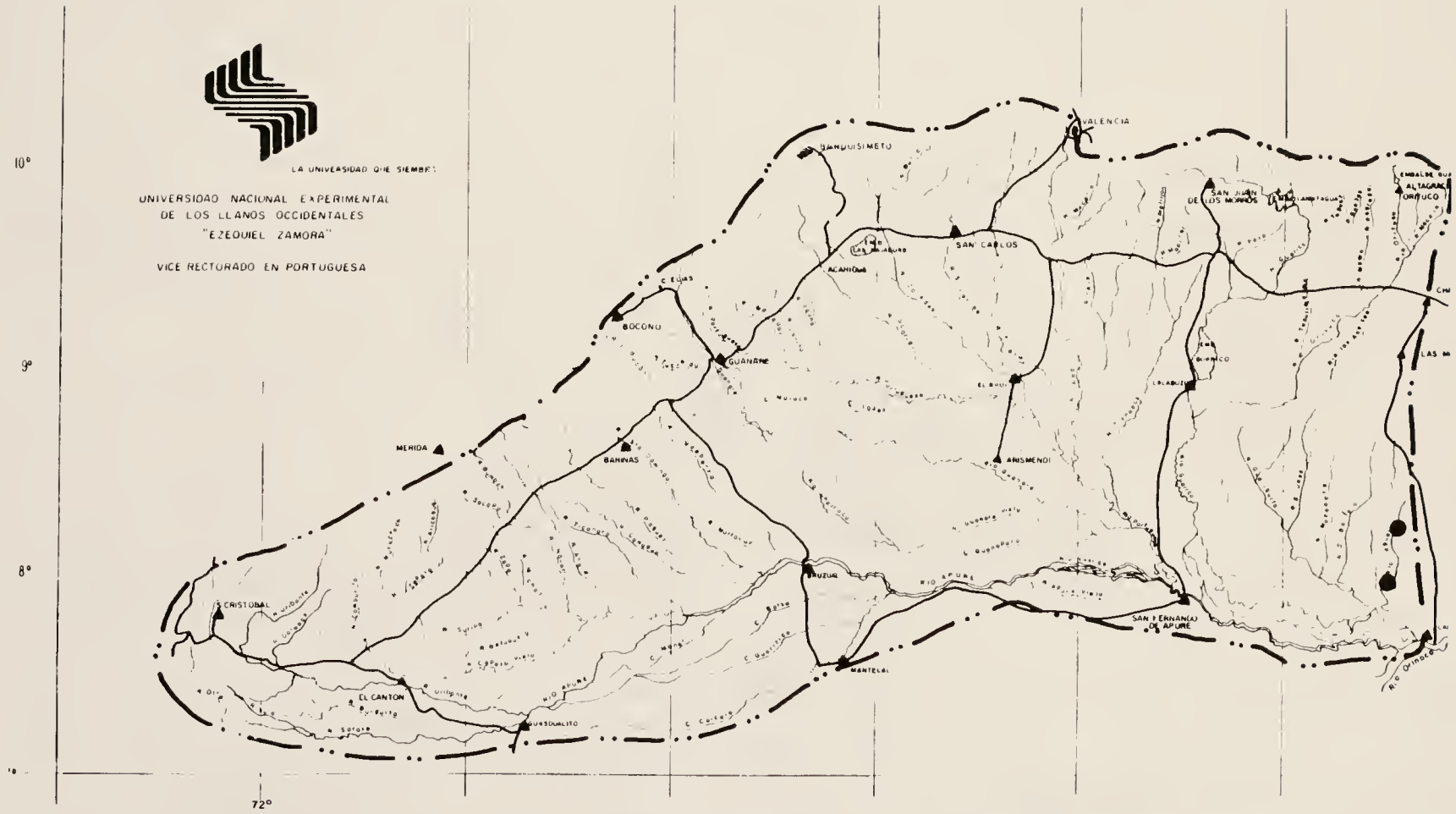
Diagnosis. The overall shape, and anal-fin ray count of 18 easily separates this species from Roeboides that have over 45 anal-fin rays. The only other fish in the Apure drainage with "tusks" is Exodon paradoxus, but it is easily distinguished by the pigmentation pattern (fig. 32).

Size. This is a small tetra, usually seen between 20-40 mm SL.

Morphology. Mammilliform everted teeth or "tusks" are present in both jaws. The lateral-line is incomplete, with only 7-8 pored scales.

Figure 211. Serrabrycon magoi.

Figure 211. Apure drainage distribution of *Serrabrycon magoi*.



CUENCA DEL RIO APURE

Counts. DR ii8-ii9; AR iii15, iv 15 or iv16; PR 12-14; VR i6i; GR 10-11 on the lower limb of the outer arch.

Measurements. GBD 28-30% SL; HL 30-33% SL.

Pigmentation. The caudal-fin base has a distinct black spot. In live and freshly preserved specimens there is a red dot above and slightly anterior to the black dot. The base color is tan in preservative. The scales on the dorsum are edged in gray but have whitish centers. The body is heavily peppered with melanophores.

Distribution and Natural History

Range. It occurs in the Orinoco Basin, and is probably present in the Amazonian Río Negro drainage as well.

Apure distribution. Map: fig. 212. It is known only from the extreme southeast corner of the drainage in the Aguaro system.

Habitat. It lives in shady blackwater streams and morichales.

Abundance. RARE.

Number of specimens examined. 7 from 2 collections.

Food. CARNIVORE. Lepidophage. It feeds on the scales of other fishes, but probably also includes aquatic invertebrates in its diet.

Reproduction. Strategy: rl. It is probably an egg scatterer that synchronizes reproduction with the onset of the rains in May to June.

Serrasalmus

The genus Serrasalmus is a taxonomic puzzle. Piranhas change shape and pigmentation as they mature, and have distinctive colors during the reproductive season. They also seem to be highly variable in coloration within populations, and among the different tributaries of the Orinoco Basin. As a result, there are many poorly described species and many synonyms. The names used here were recommended by Drs. William Fink and

Antonio Machado A., who are currently revising the subfamily. Names may change once they conclude their research. A few of the species reported here are out of alphabetical order because their names have changed several times during the preparation of this manuscript. Several nominal species cited from Venezuelan waters have not been included here; among them we find: Serrasalmus serrulatus (Valenciennes) 1849; S. spilopleura Kner 1859; S. scapularis Günther 1864; S. gymnogenys Günther 1864; and S. calmoni Steindachner 1908; S. coccogenis Fowler 1911; Serrasalmus eigenmanni Norman 1928, described from Rockstone, British Guiana; and S. nalseni Fernández Y. 1969 also from Venezuela. Some of these names may eventually replace those used in this report. Because of these uncertainties very limited synonymies are given for the five Serrasalmus species recognized here.

Serrasalmus altuvei Ramírez 1965

Caribe Azul - Blue Piranha

Fig. 212. Map: fig. 213. Couplet 26a.

Generic synonymy

Serrasalmus Lacepede 1803:283 (type species: Salmo rhombeus Linnaeus, by monotypy.

Serrasalmo Dumeril 1806:342 (type species: Salmo rhombeus Linnaeus, by monotypy).

Specific synonymy

Serrasalmus altuvei Ramírez 1965:1 (type locality: Río San José, Guárico state, Venezuela), seen; Mago L. 1970:73; Géry 1977:282; Nico & Taphorn 1986:33; Nico & Taphorn 1988:312.

Types. Holotype: MAC 65.627 (lost?). Paratypes: (MAC 65.627 (7); AFY 65.307 (7); MAC 65.641.

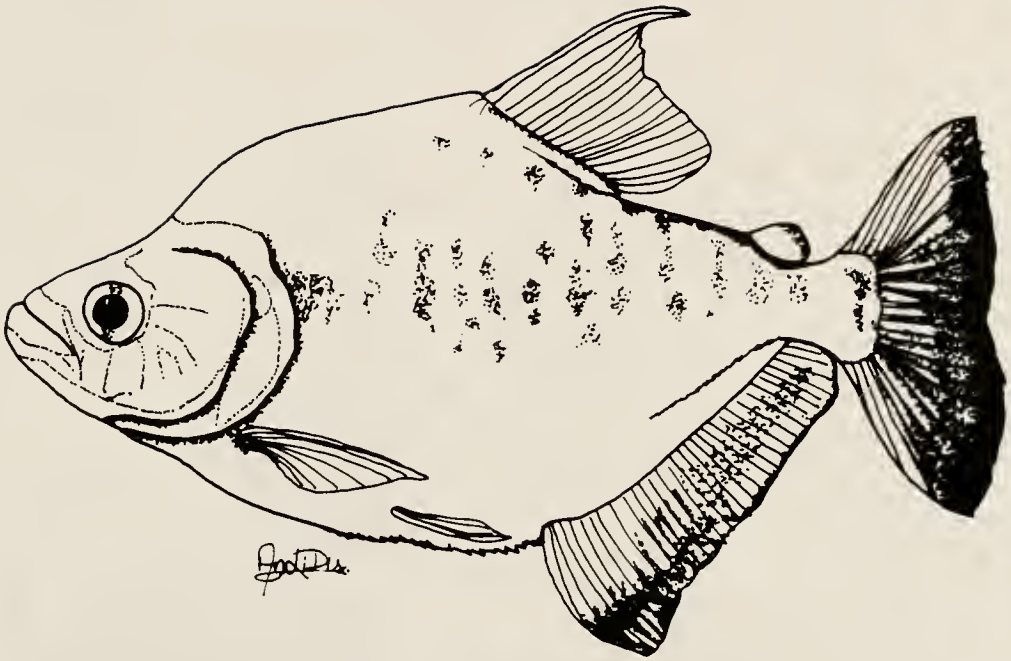


Figure 212. Serrasalmus altuvei.

Etymology. SERRA = saw, referring to the serrate ventral keel, SALMUS = salmonlike fish; ALTUVEI = after Dr. Néstor Altuve, the Director of Natural Resources of the Agriculture Ministry in Venezuela in 1965.

Description

Illustrations. Fig. 212; Ramírez 1965:1; Myers 1972:114; Román 1985:108; Nico & Taphorn 1986:33.

Diagnosis. This piranha can be recognized by the relatively deep body (its greatest depth measure less than 1.7 times in the SL) and the very steep dorsal profile. It is most similar to S. rhombeus, but lacks the massive lower jaw characteristic of that species. It differs further from that species in having 16-19 (usually 17 or more) vs 15-17, (usually 16 or fewer) dorsal-fin rays.

Size. It grows to at least 170 mm SL.

Morphology. The head is small, and the snout pointed, its dorsal profile very steep. The eye is about as long as the snout. The body is quite deep.

Counts. DR ii14-ii17; AR 34-38. Ventral scutes 25-31.

Measurements. GBD measuring less than two in SL, (56-67% SL). The dorsal-fin base is about half as long as the anal-fin base. The adipose fin is very small, its length contained almost six times in the distance from the posterior margin of the dorsal-fin base to the posterior margin of the adipose fin base.

Pigmentation. In preservative the body is heavily marked with irregular, vertically elongate dark blotches. The humeral bar is small, triangular and located just behind the opercle. The thorax and ventrum have no spots and are lighter colored than the dorsum. The dorsal fin has a faint dusky blotch. The adipose, caudal and anal fins are margined in black, with more pigment on the rays, very little on the membrane. The scales in

Figure 213. Apure drainage distribution of *Serrasalmus altuvei*.

CUENCA DEL RIO APURE

the humeral area have dark centers. The pectoral and pelvic fins are transparent (Ramírez 1965).

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 213. This species just makes it into the Apure drainage, in the area of the modules, in northern Apure state. It is probably present in the Aguaro River system as well.

Habitat. It inhabits blackwater streams with abundant aquatic vegetation.

Abundance. UNCOMMON.

Number of specimens examined. 14 from 6 collections.

Food. CARNIVORE. Piscivore. Small juveniles (20-80 mm SL) specialize on the fins of other small fishes. As they grow their diet includes mostly small fish, pieces of fish flesh and fins (Nico & Taphorn 1988).

Reproduction. Strategy: r2. It is probably an egg scatterer that synchronizes reproduction with the onset of the rains in May to June.

Importance. It is potentially valuable as an ornamental.

Serrasalmus medinai Ramírez 1965

Caribe - Piranha

Fig. 214. Map: fig. 214. Couplet 28b.

Specific synonymy

Serrasalmus medinai Ramírez 1965:1 (type locality: El Polvero, Río San José, estado Guárico, Venezuela).

Pristobrycon sp Nico & Taphorn 1986:33 (diet).

Serrasalmus caribe Nico & Taphorn 1988:311 (diet).

Types. Holotype: MAC 65.622 (lost?). Paratypes: MAC 63.604, AFY 63.200 (lost?).

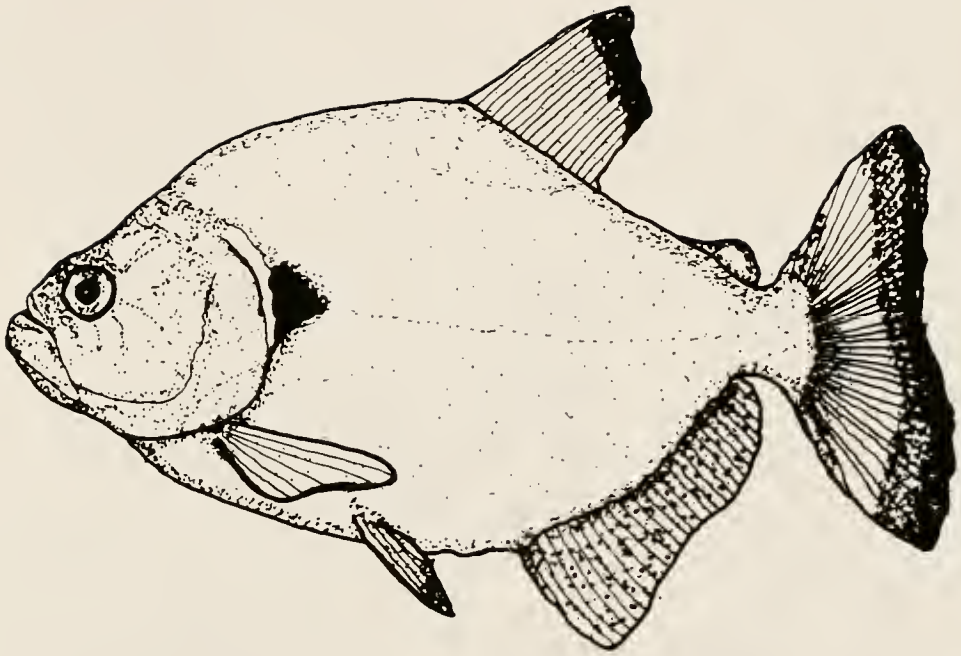


Figure 214. Serrasalmus medinai.

Comments. This species is presented out of alphabetical order because it was recently reidentified by Drs. W. Fink and Machado Allison (pers. com.), after the species had been listed and the figures and maps already drawn.

Etymology. MEDINAI = after Dr. Gonzalo Medina, chief of the Division of Fauna, Natural Resources, Ministry of Agriculture and Animal Husbandry in 1965.

Description

Illustrations. Fig. 214; Myers 1972:119; Nico & Taphorn 1986:33 (as *Pristobrycon* sp.).

Diagnosis. This piranha is easily confused with *S. rhombeus*, or *S. altuvei*, and specimens must be examined with care to make a correct identification. Ramírez (1965) distinguished them as follows: *S. altuvei* has 34-36 anal-fin rays, vs 30-31 in *S. medinai*. Maximum body depth is 49-56% SL in *S. medinai*, vs 56-67 % Sl in *S. altuvei*. In both *S. rhombeus* and *S. altuvei* the adipose fin is short, its length contained more than three times in the space between the dorsal fin and the adipose; in *S. medinai* it is longer, barely fitting twice. Another good character to distinguish them is the shape of the teeth on the roof of the mouth which are unicuspid and squared off distally, but with a more-or-less conical base and usually number fewer than five. The caudal fin is almost always edged in black (as in *S. rhombeus*). There is no black line along the base of the anal fin, but this and the dorsal fin are often edged with black. The sides are heavily spotted, and there is a dark humeral spot behind the opercle.

Size. It reaches at least 200 mm SL.

Morphology. This species is intermediate in build, between the massive *Pygocentrus caribe* and the more slender *Serrasalmus rhombeus*.

Counts. DR 17-20; AR 27-31. Ventral scutes 20-21 to pelvic fins, 31-32 total.

Measurements. (from Ramírez 1965). Eye relatively small, its diameter fitting about 1.5 times in the snout length. Dorsal-fin base length contained less than 1.7 times in anal-fin base. GBD 49-56% SL. HW 18-28% HL.

Pigmentation. See diagnosis. The humeral spot is distinct, triangular, and located just behind opercle. The caudal fin is almost always edged with black (less frequently the dorsal anal, and adipose fins are edged in black as well). The body is silvery in life, but specimens preserved in formalin often have diffuse circular spots arranged in horizontal lines (Ramírez 1965).

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 215. This species is found in the low llanos.

Habitat. It lives in lowland llanos streams and rivers.

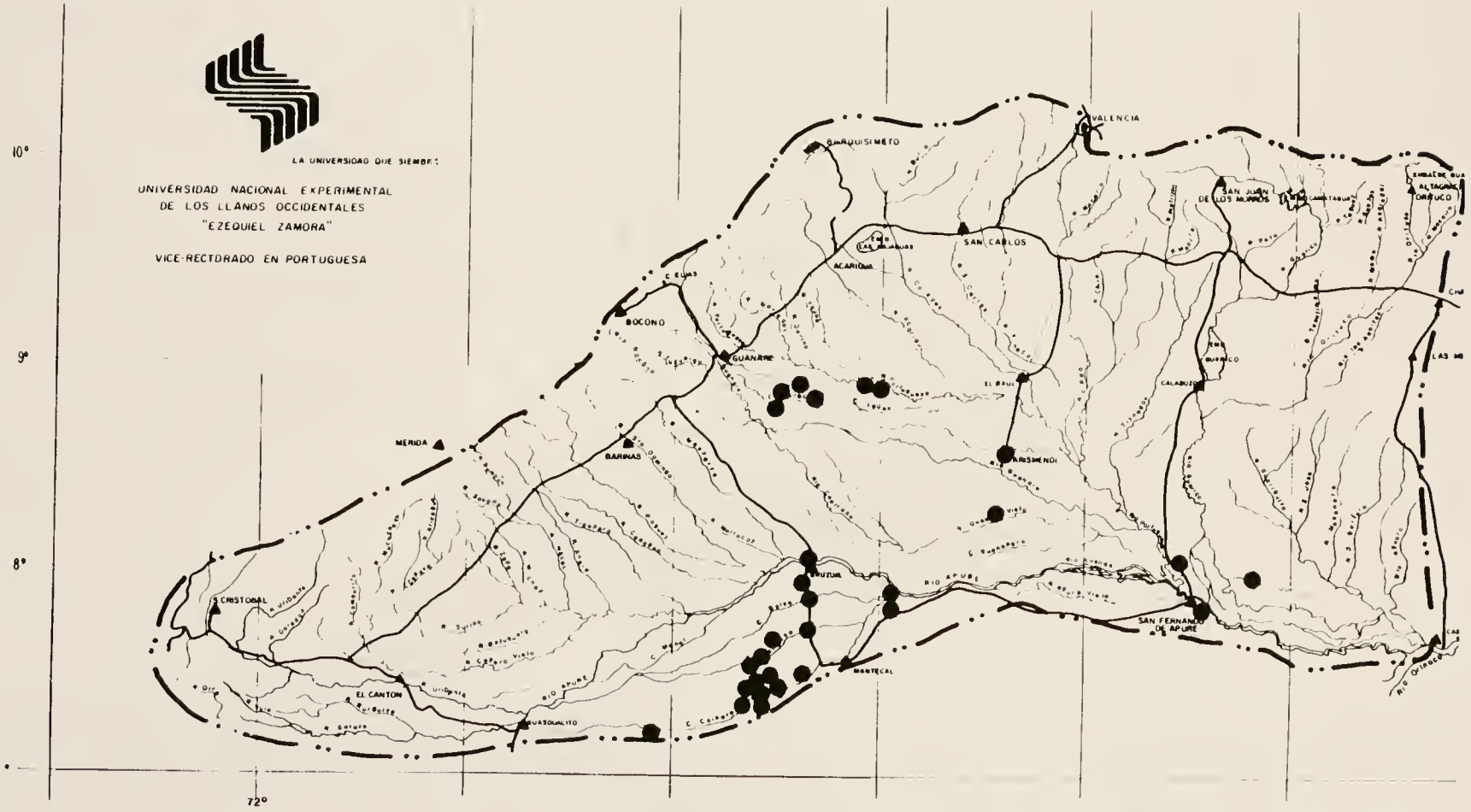
Abundance. COMMON.

Number of specimens examined. 216 from 68 collections.

Food. CARNIVORE. Piscivore. The adults bite fins from large fishes and eat smaller whole fish as well. Subadults eat fins and aquatic insects, but smallest juveniles feed on microcrustaceans (Nico & Taphorn 1986, 1988; K. Winemiller pers. com.).

Reproduction. Strategy: r2; fecundity: 3048 eggs/female; egg diameter 1.5 mm (Winemiller & Taphorn 1989). It is probably an egg scatterer. Sexual maturity is reached in one year. Spawning occurs in the first three months of the rainy season. Individuals may spawn more than once.

Figure 215. Apure drainage distribution of *Serrasalmus medinai*.



CUENCA DEL RIO APURE

Importance. This fish is only eaten when other more desirable species aren't available. In general, piranhas are not eaten in the llanos because, according to popular belief, they sometimes include humans in their diet.

Serrasalmus elongatus Kner 1860

Caribe Alargado, Caribe Pinche - Elongate Piranha

Fig. 216. Map: fig. 217. Couplets 25a & 27a.

Specific synonymy

Serrasalmus elongatus Kner 1860:44, pl. 5, fig. 12 (type locality: Río Guaporé, Mato Grosso); Géry 1977:282-3, 285; Nico & Taphorn 1986:24; Nico & Taphorn 1988:311.

Serrasalmus pingke Fernández Y. 1951:1 (type locality: Río Apure, La Defensa, al S.O de San Fernando, Venezuela).

Comments. Géry (1977) stated that Serrasalmus pingke Fernández Y. 1951 could be a synonym of this species. Since S. pingke was described from two juveniles specimens of only 55.4 and 58 mm SL, it is not possible to determine if it is identical with the Amazonian S. elongatus. Dr. Antonio Machado (pers. com.) is currently investigating the possibility that there are two elongate piranhas in the Orinoco Basin. If this should be the case, S. pingke might prove to be a valid species.

Etymology. ELONGATUS = elongate.

Description

Illustrations. Fig. 216; Norman 1928:806; Fernández Y. 1951:1 (as S. pingke); Géry 1977:282; Román 1985:106, (as S. pingke); Nico & Taphorn 1986:33.

Diagnosis. The relatively elongate body (for a piranha) is sufficient to identify this species.

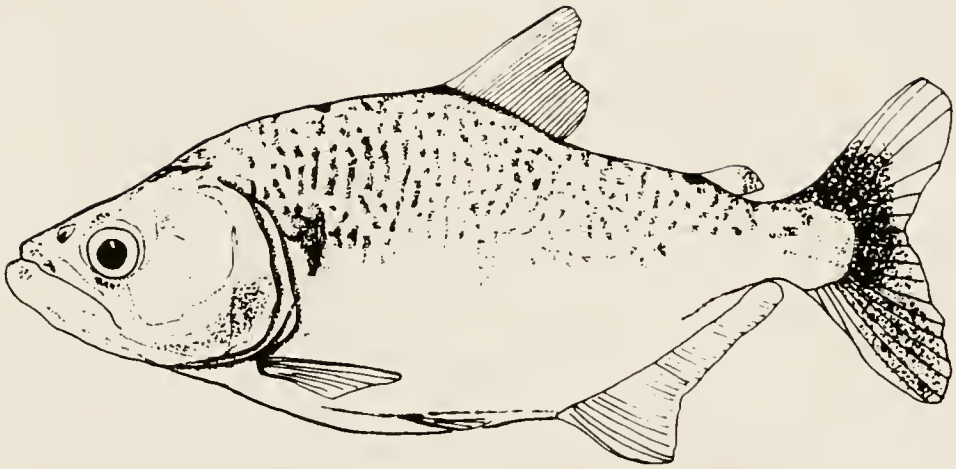


Figure 216. Serrasalmus elongatus.

Size. It reaches at least 250 mm SL.

Morphology. This is the most elongate piranha in Venezuela.

Counts. DR ii13.

Measurements. GBD 42% SL.

Pigmentation. The opercle has a dark smudge at the angle. The humeral spot is triangular with the point down, and is located behind the opercle. The adipose fin is pigmented at its tip. The caudal fin is dark. In life this species is plain silvery most of the year. In the breeding season, the chest becomes reddish. When it is preserved the dorsum and upper sides have numerous darker flecks and blotches that often run together to form vertical bars, especially in the humeral area.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 217. It is known only from northern Apure state and the Aguaro River system.

Habitat. It lives in blackwater streams of the low llanos.

Abundance. UNCOMMON. Adults of this species are seldom collected with seines, so their apparent scarcity could be an artifact of our collecting methods. Most large specimens were captured on hook and line.

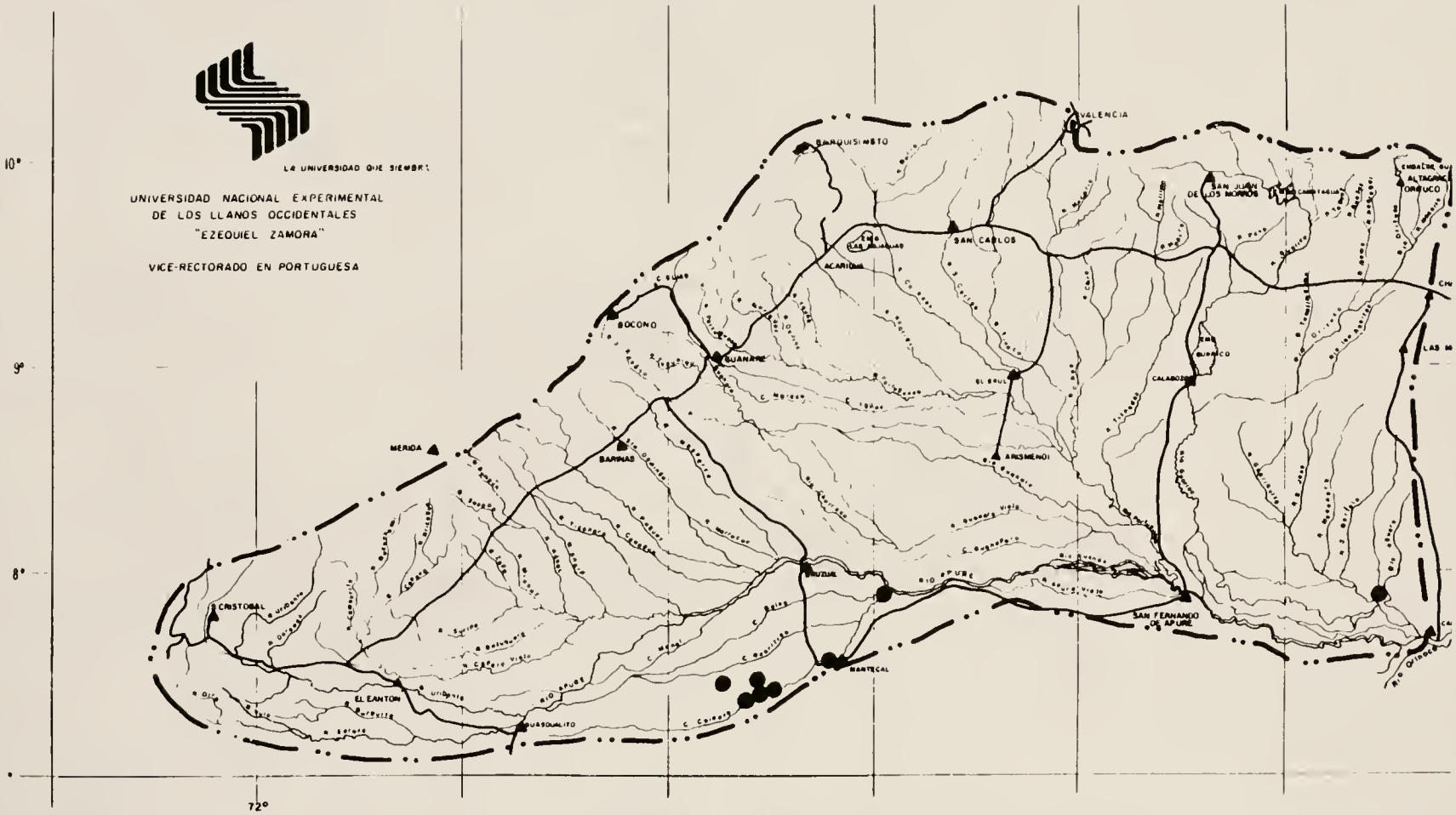
Number of specimens examined. 51 from 17 collections.

Food. CARNIVORE. Piscivore. The adults clip fins from large fishes and also eat whole small fish, subadults eat fins and aquatic insects, smallest juveniles take microcrustaceans (Nico & Taphorn 1988; K. Winemiller pers. com.).

Reproduction. Strategy: r2. It is probably an egg scatterer that synchronizes reproduction with the onset of the rains in May to June.

Importance. It is consumed locally.

Figure 217. Apure drainage distribution of Serrasalmus elongatus.



CUENCA DEL RIO APURE

Serrasalmus irritans Peters 1877

Caribe Pinche - Slender Piranha

Fig. 218. Map: fig. 219. Couplet 27b.

Specific synonymy

Serrasalmo irritans Peters 1877:472 (type locality: San Fernando de Apure, Venezuela).

Serrasalmus irritans Eigenmann & Eigenmann 1891:60; Schultz 1944b:255 (as synonym of S. spilopleura); Nico & Taphorn 1988:312.

Serrasalmus eigenmanni: Schultz 1944b:255 (Río Caripe, Venez.); Taphorn & Lilyestrom 1983:70 (Apure modules, Venez.); Nico & Taphorn 1986:31, 33 (Apure drainage, Venez.).

Comments. Doubt still exists as to the true identity of this species (as for most piranhas), but at least it was described from the Apure drainage. I have called this species S. eigenmanni in previous works. There may be a complex of species involved here.

Etymology. IRRITANS = bothersome.

Description

Illustrations. Fig. 218; Román 1985:108; Nico & Taphorn 1986:31,33 (as Serrasalmus eigenmanni).

Diagnosis. This species is extremely compressed. It has a very slender head (the least interorbital width measures more than 3.3 times in the head length). The black markings along the base of the caudal fin (fig. 218) are also characteristic of this species. It is further distinguished by having 32 or more anal-fin rays.

Size. It grows to about 150 mm SL.

Counts. DR ii13; AR 34.

Pigmentation. In preservative these fishes have the upper sides flecked with numerous black spots. The caudal fin is black along its base and the anal fin is sometimes darkly pigmented as well.

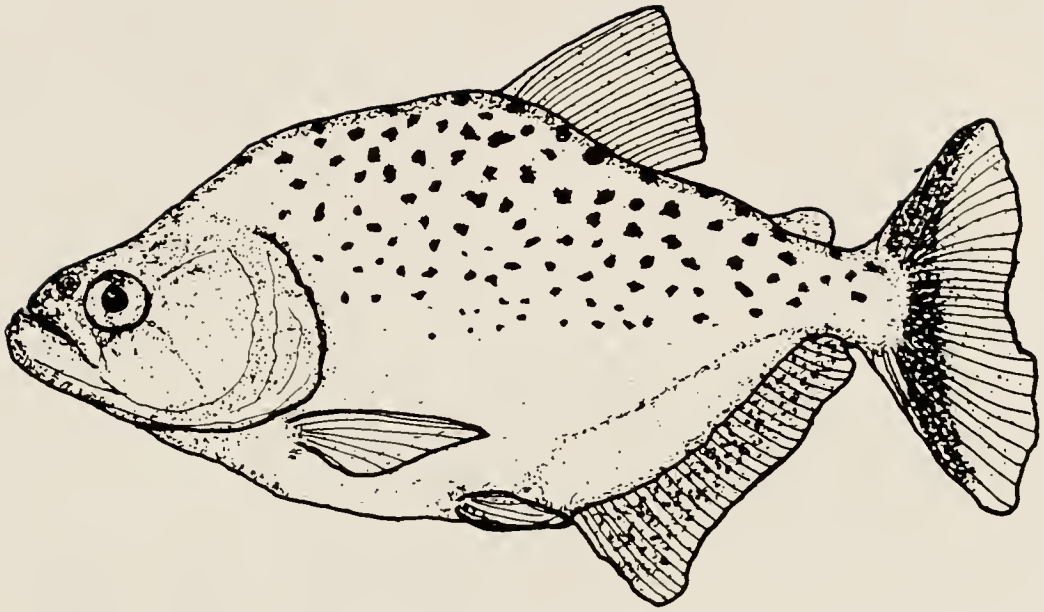
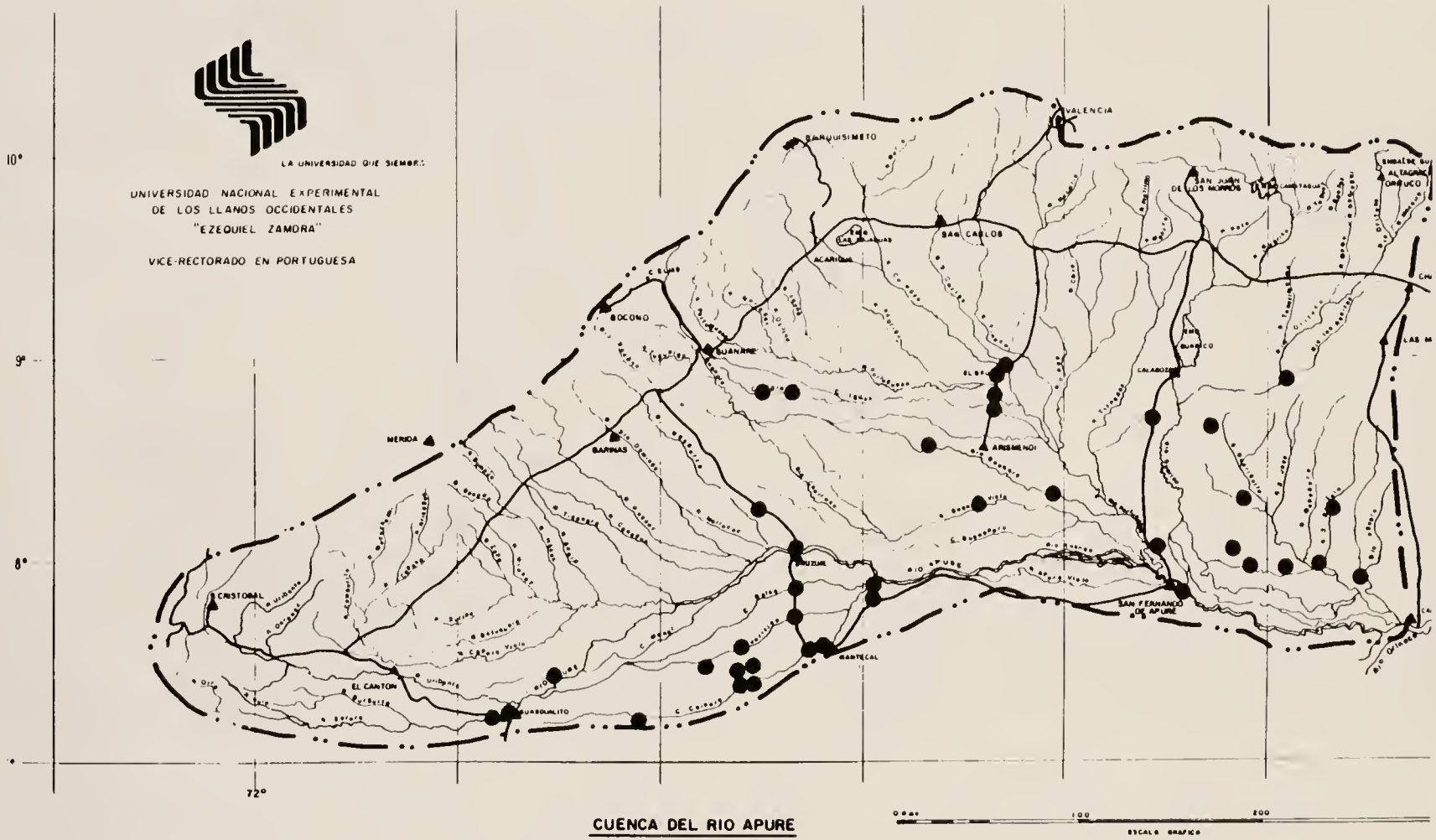


Figure 218. Serrasalmus irritans.

Figure 219. Apure drainage distribution of *Serrasalmus irritans*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It is known only from the Orinoco Basin.

Apure distribution. Map: fig. 219. It is common in the lower llanos, but is also found in the piedmont.

Habitat. It inhabits lowland llaneran streams.

Abundance. COMMON. This is usually the second most abundant piranha in most biotopes (after *Pygocentrus caribe*). It is widespread throughout the drainage.

Number of specimens examined. 744 from 142 collections.

Food. CARNIVORE. Piscivore. Adults mostly take whole small fish but clip fins from large fishes as well. Juveniles specialize in eating fins, which are frequently the only item in their stomachs. Small aquatic insects and microcrustaceans comprise the diet of the smallest juveniles (Nico & Taphorn 1986, 1988; K. Winemiller pers. com.).

Reproduction. Strategy: r2; fecundity: 280 eggs/female; egg diameter: 1 mm. Sexual maturity is reached in one about year. Spawning occurs during the first three months of the rainy season. It is probably an egg scatterer (Winemiller & Taphorn 1989).

Importance. It is consumed locally.

Serrasalmus rhombeus (Linnaeus) 1766

Caribe Blanco, Caribe Mondonguerro, Caribe Ojo Rojo

White Piranha, Red-Eye Piranha

Fig. 220. Map: fig. 221. Couplet 26b.

Specific synonymy

Salmo rhombeus Linnaeus 1766:514 (type locality: Surinam), seen.

Serrasalmus rhombeus Mago L. 1970:73; Géry 1977:283, 286, 288-91; Novoa 1982:273 (biology); Machado A. & García 1986:193 (diet); Nico & Taphorn 1986:24; Nico & Taphorn 1988:312.

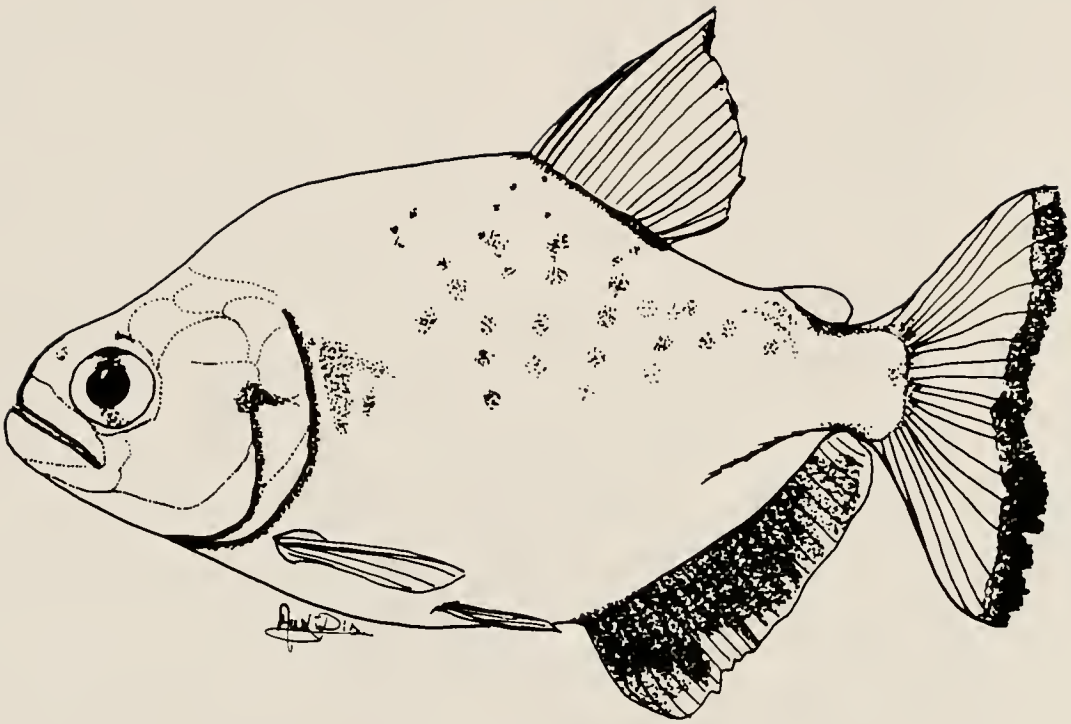


Figure 220. Serrasalmus rhombeus.

Comments. Géry (1977) stated that S. medinai Ramírez 1965 is probably a synonym of this species. The name S. rhombeus is used for forms that range from Surinam and the Guianas, as well as the Orinoco and Amazon basins. Further research will probably justify taxonomic recognition of some of these geographically isolated populations. In the Orinoco drainage it is possible that a complex of species is included under this name.

Etymology. RHOMBEUS = probably refers to their rhomboid shape when older.

Description

Illustrations. Fig. 220; Myers 1972:122; Géry 1977:288, 291; Novoa et al. 1982:fig. 9; Román 1985:110; Axelrod et al. 1971:F-556.05, 556.06, 559.00; Nico & Taphorn 1986:40.

Diagnosis. In contrast to the situation observed in S. caribe with which this species is most often confused (see diagnosis of that species), the teeth on the roof of mouth, are triangular, bi- to tricuspid (the lateral cusps are small and hard to see), and usually number seven or more. The caudal fin is usually edged with black. There are 15-17 (usually 16 or 17) dorsal-fin rays. The spots on the sides are usually rounded, and not vertically elongated. Specimens over 150 mm have a massive lower jaw; the jaw width at the commissure is greater than the eye diameter.

Size. Novoa et al. (1982) reported a specimen of 295 mm TL that weighed 0.47 kg. Axelrod et al. (1971) claimed that this species can reach 420 mm TL.

Morphology. This species changes shape considerably as it grows. Young specimens are compressed and relatively elongate. As they grow they become stockier, and have a relatively deeper body. Géry (1972) discussed these allometric changes at length.

Counts. DR ii13; AR 33.

Pigmentation. This species changes its pigmentation as it grows. Young specimens are basically whitish or yellowish with a silver-gray background color on the body, and a reddish abdomen. The fins are hyaline except for the caudal fin which is edged in black, and the pectoral fins which are reddish. Individuals darken progressively until they turn completely black with purple and gold flecks on the flanks. The fins darken along with the rest of the body, and eventually can become all black. The eye is usually bright red at all sizes.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins of Brazil, Venezuela and Colombia, and in Guyana and Surinam.

Apure distribution. Map: fig. 221. Curiously, this species has not been taken in the far western portion of the drainage. It is found throughout the lower portions of the rest of the drainage.

Habitat. *S. rhombeus* lives in lowland streams throughout the drainage, but is more common in black and clearwater streams.

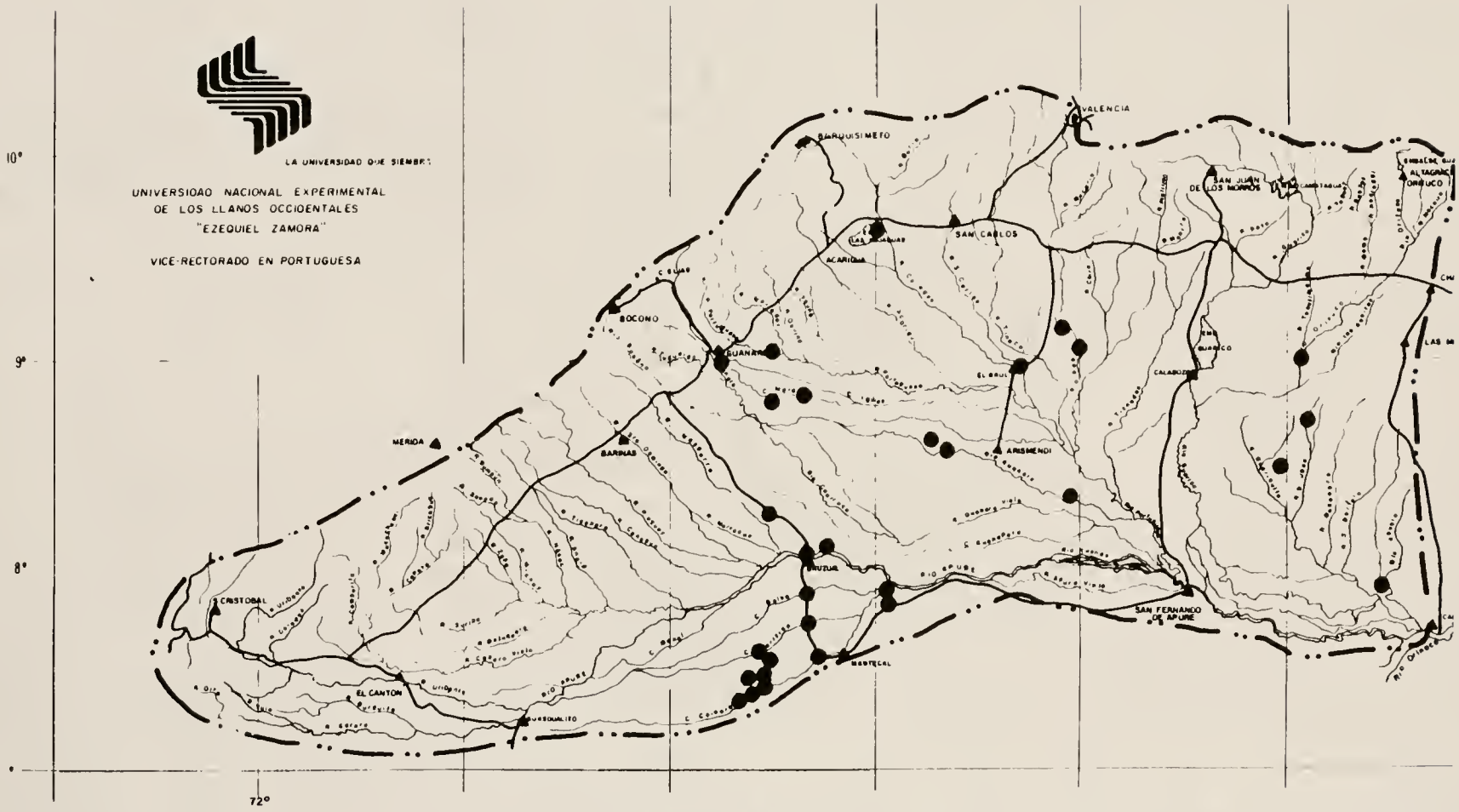
Abundance. COMMON.

Number of specimens examined. 136 from 61 collections.

Food. CARNIVORE. Piscivore. This species is known to feed both during the day and at night. Adults bite fins from large fishes and eat small whole fish, subadults eat fins and aquatic insects, and the smallest juveniles eat microcrustaceans (Nico & Taphorn 1988; K. Winemiller pers. com.).

Reproduction. Strategy: r2; fecundity: 4303 eggs/female; egg diameter: 2.25 mm (Winemiller & Taphorn 1989). Novoa et al. (1982) found maturing females in the Orinoco Delta in March. In the llanos spawning occurs

Figure 221. Apure drainage distribution of *Serrasalmus rhombeus*.



CUENCA DEL RIO APURE

during the first three months of the rainy season. Sexual maturity is reached in one year. Individuals may spawn more than once.

Importance. It is consumed locally.

Tetragonopterus argenteus Cuvier 1817

Sardina - Silver-Foil Tetra

Fig. 54 & 222. Map: fig. 223. Couplet 84a.

Generic synonymy

Tetragonopterus Cuvier 1817:166 (type species: Tetragonopterus argenteus Cuvier, by monotypy).

Specific synonymy

Tetragonopterus argenteus Cuvier 1817 (1818):455 (type locality: Bahia, Brazil); Pellegrin 1899:157; Schultz 1944b:338; Mago L. 1970:73; Géry 1977:448-50, 454.

Etymology. TETRA = four, GONO = angle, PTERUS = wing or fin, thus meaning square winged; ARGENTEUS = silvery.

Description

Illustrations. Fig. 54 & 222; Eigenmann 1917:pl. 2, 4; Géry 1977:448, 449; Román 1985:177; Axelrod et al. 1971:F-578.21, 578.22.

Diagnosis. The decurved lateral-line, deep body, and relatively large eye are characteristic of this species. The other species in the genus T. chalceus is present in neighboring drainages, and was reported by Pellegrin (1899) from the Apure River. It is less deep bodied, has only 3-4 scales bordering the occipital process (vs 5-7), and has fewer anal rays 32-33 (vs 36-37 in T. argenteus).

Size. It grows to about 110 mm TL, but most individuals are smaller, between 40-70 mm SL.

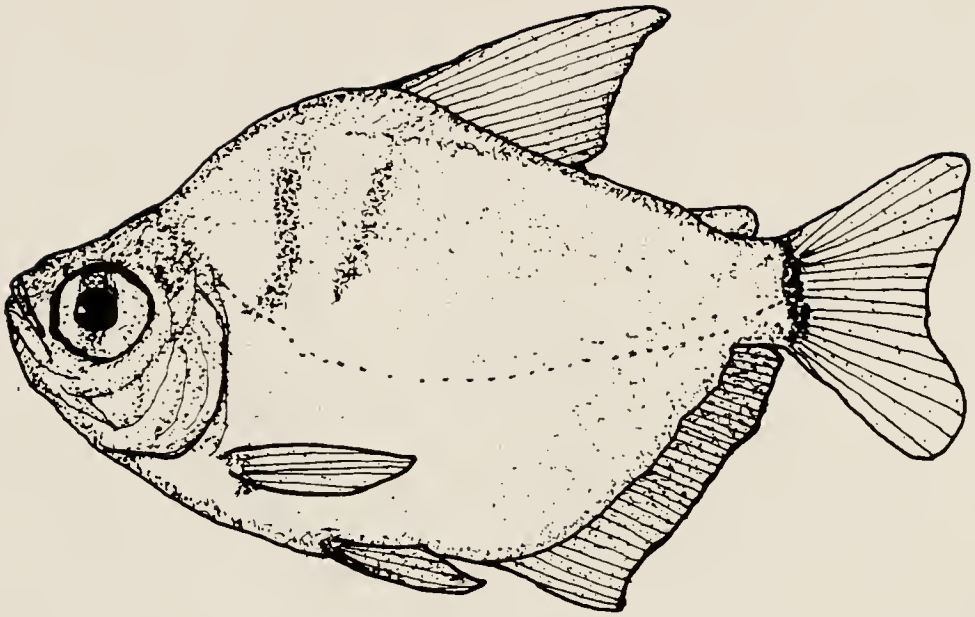


Figure 222. Tetragonopterus argenteus.

Morphology. The body is deep and greatly compressed, with a steep upward curve to the dorsal profile. The complete lateral line is decurved, and passes close to the anal-fin base.

Counts. DR 11; AR 36-37; LLS 31-35; TS 9 above LL, 4-5 below.

Measurements. The eye is very large, measuring 3.0 times in the head length in the adult, and 2.25 in young.

Pigmentation. The body is silvery with a double humeral bar, and a large caudal blotch. The pelvic fins and anterior anal fin are red.

Distribution and Natural History

Range. It occurs in the Amazon, Orinoco and La Plata basins, as well as in Guyana.

Apure distribution. Map: fig. 223. It is found throughout the llanos.

Habitat. This fish is usually found in slower parts of streams and rivers.

Abundance. COMMON.

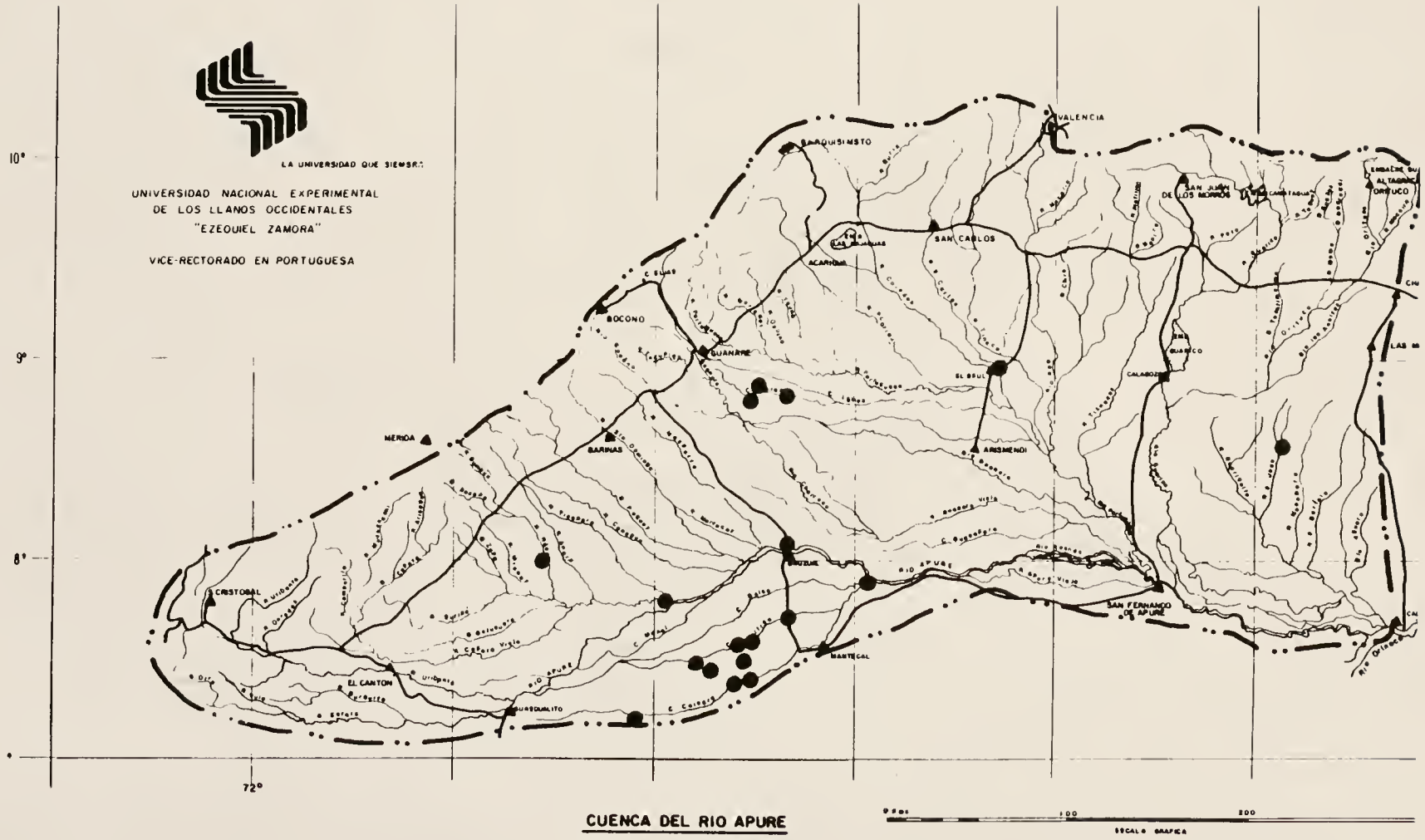
Number of specimens examined. 178 from 35 collections.

Food. OMNIVORE. It feeds on seeds, aquatic insects, and fish carrion (K. Winemiller, pers. com.).

Reproduction. Strategy: r2; fecundity is high with 3398 eggs/ females; egg diameter: 1.00 mm (Winemiller & Taphorn 1989). Sexual maturity is reached in about one year. Spawning occurs during the first month of the rainy season. Individuals usually spawn only once per year (Winemiller & Taphorn 1989). Sexual dimorphism is evident. Males are smaller and slimmer and with prolonged dorsal-fin rays in older, more mature specimens (Axelrod et al. 1971).

Importance. Ornamental.

Figure 223. Apure drainage distribution of *Tetragonopterus argenteus*.



CUENCA DEL RIO APURE

Triportheus

I have identified what I believe to be three species of Triportheus among the collections made in the Apure drainage for this report, but assigning correct names to the three has proven difficult. The differences are presented in the key, but there is so much variation in color and meristics that I suspect the situation may be more complex. Perhaps hybridization is involved. At any rate, the three forms are: a red-tailed, very deep-bodied species, called here T. sp. "cola roja" (meaning red tail in Spanish) and T. rotundatus by other authors; a species that usually has a black stripe though the tail, but can also have some red in the tail, T. angulatus; and an elongate, yellow-tailed form T. albus found so far only in main river channels. All seem to grade into one another.

Triportheus albus Cope 1872

Arenca Cola-amarilla - Yellow-Tailed Triportheus

Fig. 224. Map: fig. 225. Couplet 75b.

Generic synonymy

Triportheus Cope 1872:264 (type species: Triportheus flavus Cope, by subsequent designation of Jordan 1919:363); Myers 1940:170 (suppression of Chalcinus).

Chalcinus (non Rafinesque 1815) Valenciennes in Cuvier & Valenciennes 1849:258 (type species: Chalcinus brachipomus Valenciennes, by subsequent designation of Eigenmann 1910:440).

Specific synonymy

Triportheus albus Cope 1871:264, pl. 14, fig. 3 (type locality: Ambyiacu River, eastern Ecuador), seen; Géry 1977:336, 343.

Comments. Several authors have reported T. elongatus from Venezuela (Steindachner 1879; Eigenmann & Eigenmann 1891; Fowler 1911; Eigenmann &

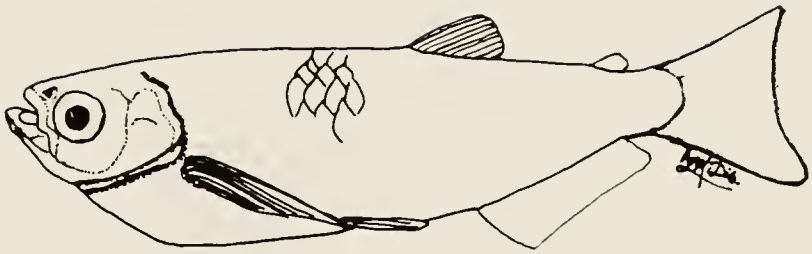


Figure 224. Triportheus albus.

Allen 1942; Schultz 1944b), but none of these records are specifically from the Apure drainage. Perhaps their identifications were correct but it is also possible that these refer to this species. The genus is in need of complete revision.

Etymology. TRI = three, PORTHEUS = "openings" or "holes" from the Latin "portus" meaning openings or holes; ALBUS = white, Latin.

Description

Illustrations. Fig. 224; Géry 1977:336.

Diagnosis. The caudal fin is usually yellow. The body is elongate and slender, its greatest depth measures 3.4 times in the SL. There are usually only five (sometimes six) scales between the lateral line and the dorsal-fin origin.

Size. It can reach 120 mm SL, but most individuals are smaller.

Morphology. The body is elongate, and highly compressed with a keeled breast. The pectoral fins are placed low on the body and are expanded and stiff.

Counts. There is one tooth behind the main row on the dentary.

Pigmentation. The body is silvery and the tail yellow.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 225. It has been taken only from big rivers.

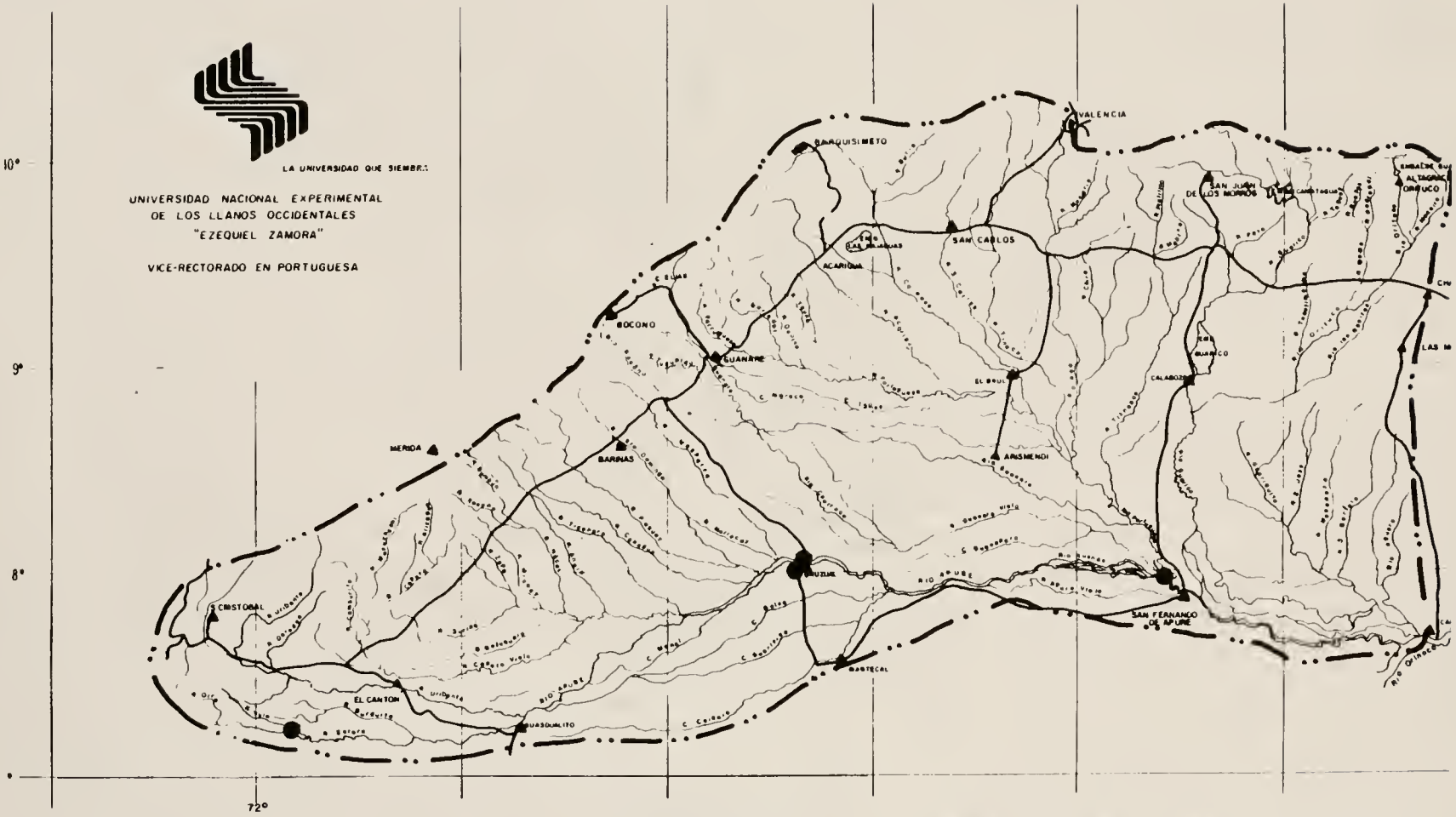
Habitat. T. albus seems to be restricted to big rivers.

Abundance. RARE.

Number of specimens examined. 181 from 5 collections.

Food. OMNIVORE. It feeds on seeds, terrestrial insects, and aquatic insects. Goulding (1980) noted that the species that live in

Figure 225. Apure drainage distribution of *Triportheus albus*.



CUENCA DEL RIO APURE

larger rivers and feed on potamoplankton have finer gill rakers than the other Amazonian species. This is not the case for this species, which has gillrakers of about the same size as the other two.

Reproduction. Strategy: r2; fecundity: about 3000 eggs/female; egg diameter: 1.8 mm (Winemiller & Taphorn 1989). It is probably an egg scatterer. Spawning occurs annually during the first month of the rains.

Importance. It is often used as bait by commercial fishermen.

Triportheus angulatus (Spix) 1829

Arenca - Triportheus

Fig. 226. Map: fig. 227. Couplet 75a.

Specific synonymy

Chalceus angulatus Spix in Agassiz 1829:67, pl. 34 (type locality: "in Brasiliae aequinoctialis fluviis"), seen.

Chalcinus angulatus Steindachner 1879:157 (Ciudad Bolivar); Eigenmann & Eigenmann 1891:56 (Orinoco); Eigenmann & Allen 1942:261 (Orinoco Basin); Schultz 1944b:274; Mago L. 1970:73; Géry 1977:332-3, 343, 346.

Etymology. ANGULATUS = probably referring to the sharp angle of the sharply keeled chest.

Description

Illustrations. Fig. 226; Weitzman 1960:fig. 1; Géry 1977:333. Román 1985:154.

Diagnosis. The caudal fin is usually red, sometimes with the central rays black. The body is deeper in this species than in the other Apure drainage Triportheus spp., its depth measures less than three times in the SL. There are usually six scales between the lateral line and the dorsal-fin origin.

Size. It can reach some 200 mm SL, but is usually found smaller.

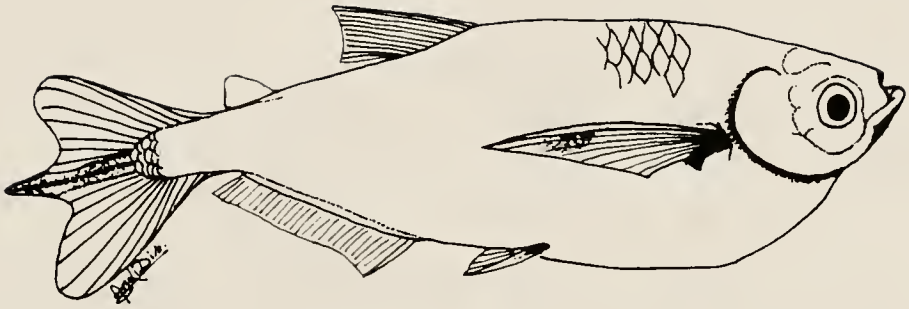


Figure 226. Triportheus angulatus.

Morphology. The body is elongate, and highly compressed with a keeled breast. The pectoral fins are set low on the body, and are enlarged and stiff. The swim bladder is two chambered, with the anterior chamber rounded, the posterior one longer and tapering to a point.

Counts. DR 11-12; PR 12; AR 31-36; LLS 32-34; TS 6 (above lateral line). The dentary has one large tooth behind the main row.

Measurements. GBD 35-43% SL.

Pigmentation. This species is extremely variable. Usually the base color is silvery, but the upper half of the fish is sometimes dark brown and the lower half whitish. There is a dark black lateral stripe in some populations that continues uninterrupted onto the extended central caudal rays found in some individuals.

Distribution and Natural History

Range. It occurs in the Amazon and Orinoco basins.

Apure distribution. Map: fig. 227. It is known from throughout the lower llanos.

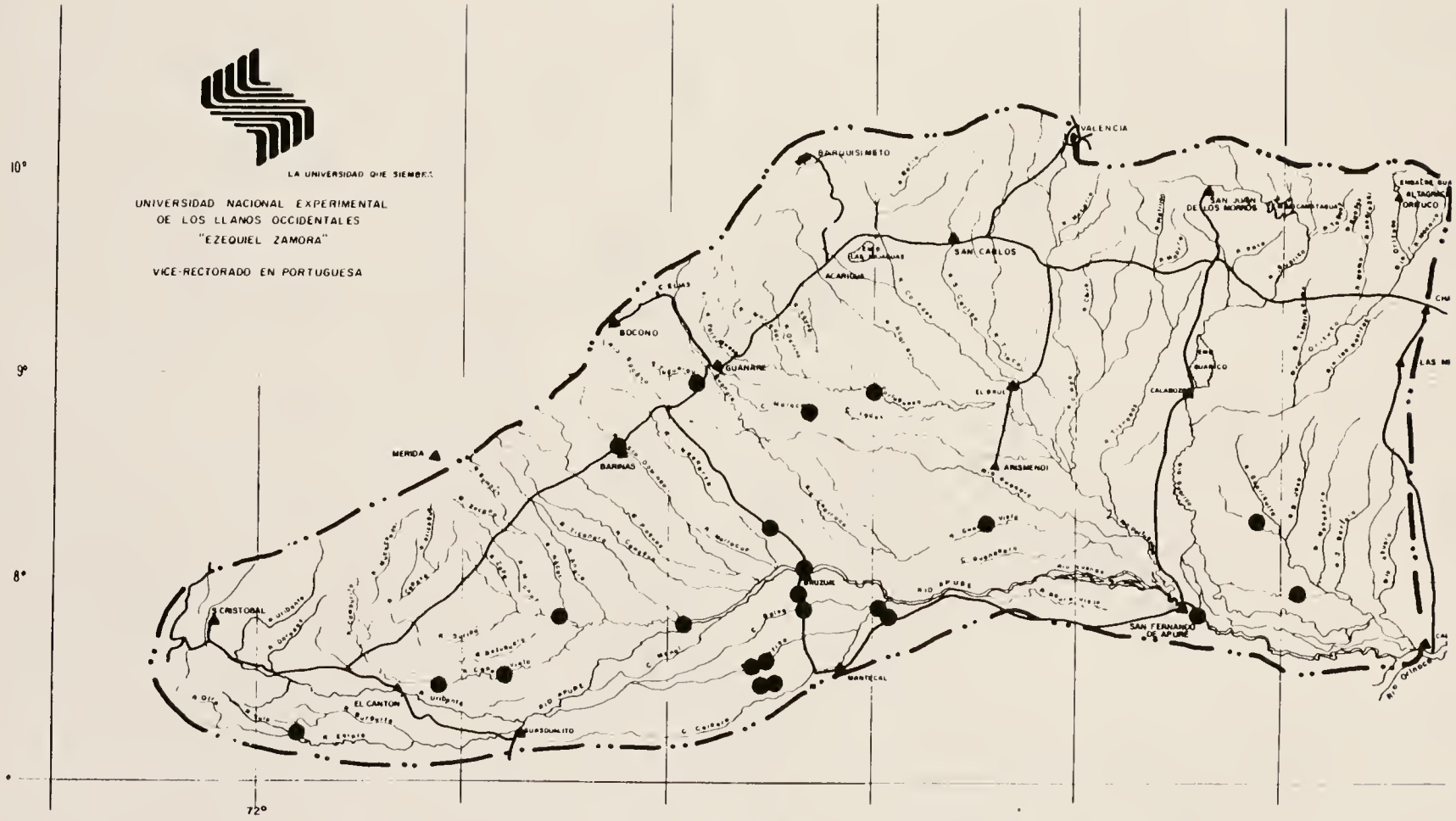
Habitat. It prefers flowing waters and is found in most llaneran streams.

Abundance. COMMON.

Number of specimens examined. 105 from 39 collections.

Food. OMNIVORE. It feeds on seeds, terrestrial and aquatic insects, and small fishes. One 135 mm SL specimen from the Río Tucupido contained a 13.7 mm SL *Creagrutus* in its stomach. Goulding (1980) noted that in Brazil,the deeper-bodied species *T. angulatus*, included more terrestrial insects in its diet than the sympatric, more elongate species *T. elongatus*. He supposed that the deeper body allowed *T. angulatus* to dash more quickly up to the surface to catch fallen prey.

Figure 227. Apure drainage distribution of *Triportheus angulatus*.



CUENCA DEL RIO APURE

Reproduction. Strategy: r2; fecundity: about 3000 eggs/female; egg diameter: 1.8 mm. It is probably an egg scatterer. Spawning occurs annually during the first month of the rains (Winemiller & Taphorn 1989).

Migrations. During the dry season it is often observed below the tailraces of dams along with *Prochilodus mariae*, attempting to migrate upstream. It normally would descend again at the end of the dry season in rivers that haven't been impounded.

Importance. It is used as bait by commercial fishermen.

Triportheus sp. "cola roja"

Arenca Cola Roja - Red-Tailed Triportheus

Fig. 228. Map: fig. 229. Couplet 74a.

Specific synonymy

?*Triportheus brachypomus* Pellegrin 1899:157 (Apure River); ?Fowler 1931:408 (Caño Guanoco, Venez.).

?*Triportheus rotundatus* Schultz 1944b:274.

Comments. This could be *T. rotundatus* (Schomburgk) 1841 from British Guiana, but the coloration, counts and measurements given don't exactly agree with that species.

Description

Illustrations. Fig. 228; Román 1985:155.

Diagnosis. The caudal fin is usually red in the species, but is quite variable and often has the central rays black. There are usually seven scales between the lateral-line and the dorsal-fin origin.

Size. It can reach 200 mm SL, but most individuals are smaller.

Morphology. The body is elongate and highly compressed. The breast is keeled. The enlarged, stiff pectoral fins are placed low on the body.

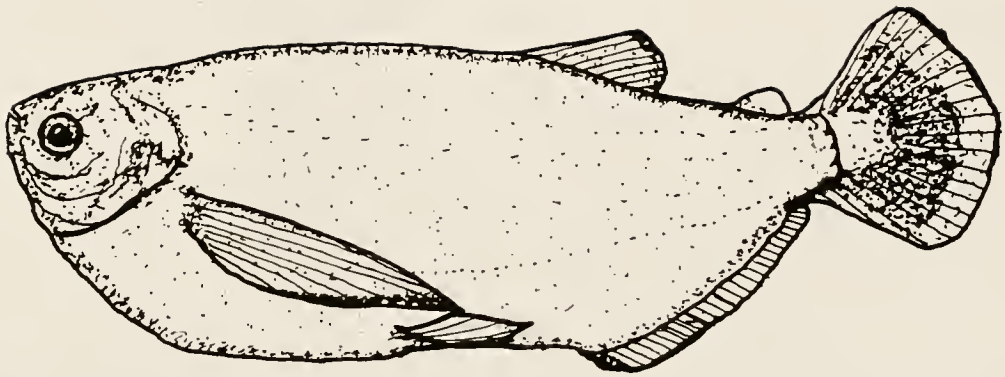
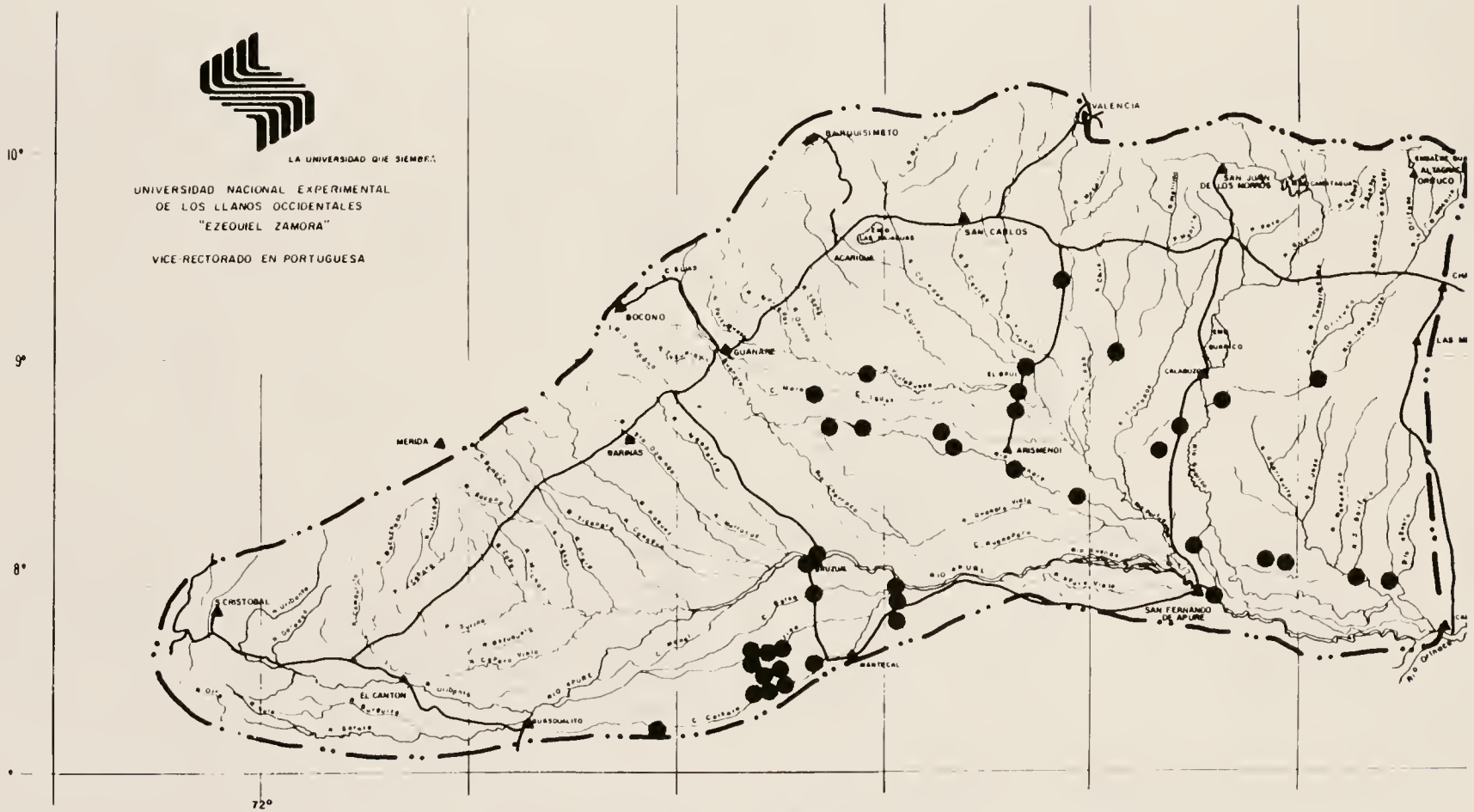


Figure 228. Triportheus sp. "cola roja".

Figure 229. Apure drainage distribution of Triportheus sp. "cola roja".



CUENCA DEL RIO APURE

Counts. LLS 34-36; TS 7-8 (above lateral line); AR 31-37. The dentary has one large tooth behind the main row.

Measurements. GBD 34-40% SL.

Pigmentation. The body is silvery and the tail is red, sometimes with the central caudal rays dark.

Distribution and Natural History

Range. It occurs in the Orinoco Basin, and perhaps Guyana.

Apure distribution. Map: fig. 229. It seems to be absent from the western portion of the drainage, but are otherwise common in the lower parts of the drainage.

Habitat. It lives in flowing waters throughout the eastern portion of the drainage.

Abundance. COMMON.

Number of specimens examined. 1,045 from 107 collections.

Food. OMNIVORE. It feeds on seeds, and on terrestrial and aquatic insects.

Reproduction. Strategy: r2; fecundity: about 3000 eggs/female; egg diameter: 1.8 mm (Winemiller & Taphorn 1989). It is probably an egg scatterer. Spawning occurs annually during the first month of the rainy season.

Migrations. See the previous account.

Importance. It is often used as bait by commercial fishermen.

Xenagoniates bondi Myers 1942

Sardinita Transparente - X-ray Tetra

Fig. 230. Map: fig. 231. Couplet 3a.

Generic synonymy

Xenagoniates Myers 1942:90 (type species: Xenagoniates bondi, by monotypy).

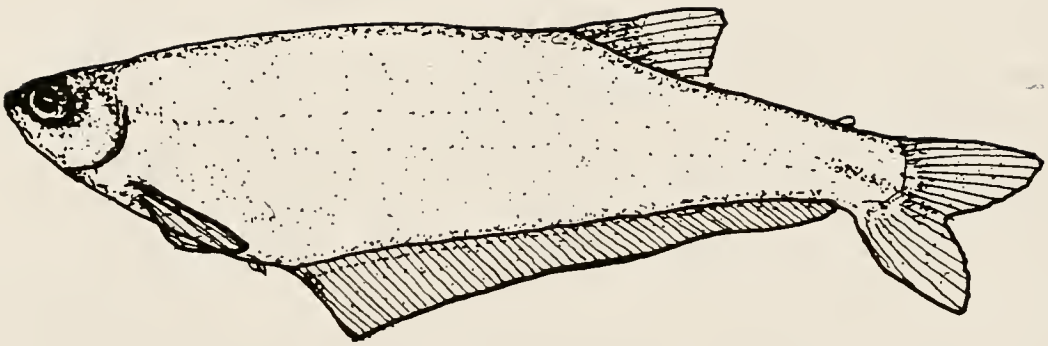


Figure 230. Xenagoniates bondi.

Specific synonymy

Xenagoniates bondi Myers 1942:90, fig. 1 (type locality: Río Amana, 6 km E of Santa Barbara and 35 km W of Maturín, Monagas state, Venezuela), seen; Schultz 1944b:312; Mago L. 1970:73; Géry 1977:341, 347.

Types. Holotype: CAS-SU 36486. Paratopotypes: CAS-SU 46487 (3).

Etymology. XENA = from the Greek for strange, GONIATES = probably from the Greek "gonia" meaning angled, perhaps in allusion to the unusual shape of this fish, there is also a genus of characid Agoniates which may have been used as a root; BONDI = after F. Bond, who worked on a mosquito control program for in Venezuela and collected the holotype.

Description

Illustrations. Fig. 230; Géry 1977:341.

Diagnosis. The posterior position of the dorsal fin and the extremely long anal fin (with more than 55 rays) are characteristic of this species. An adipose fin is present.

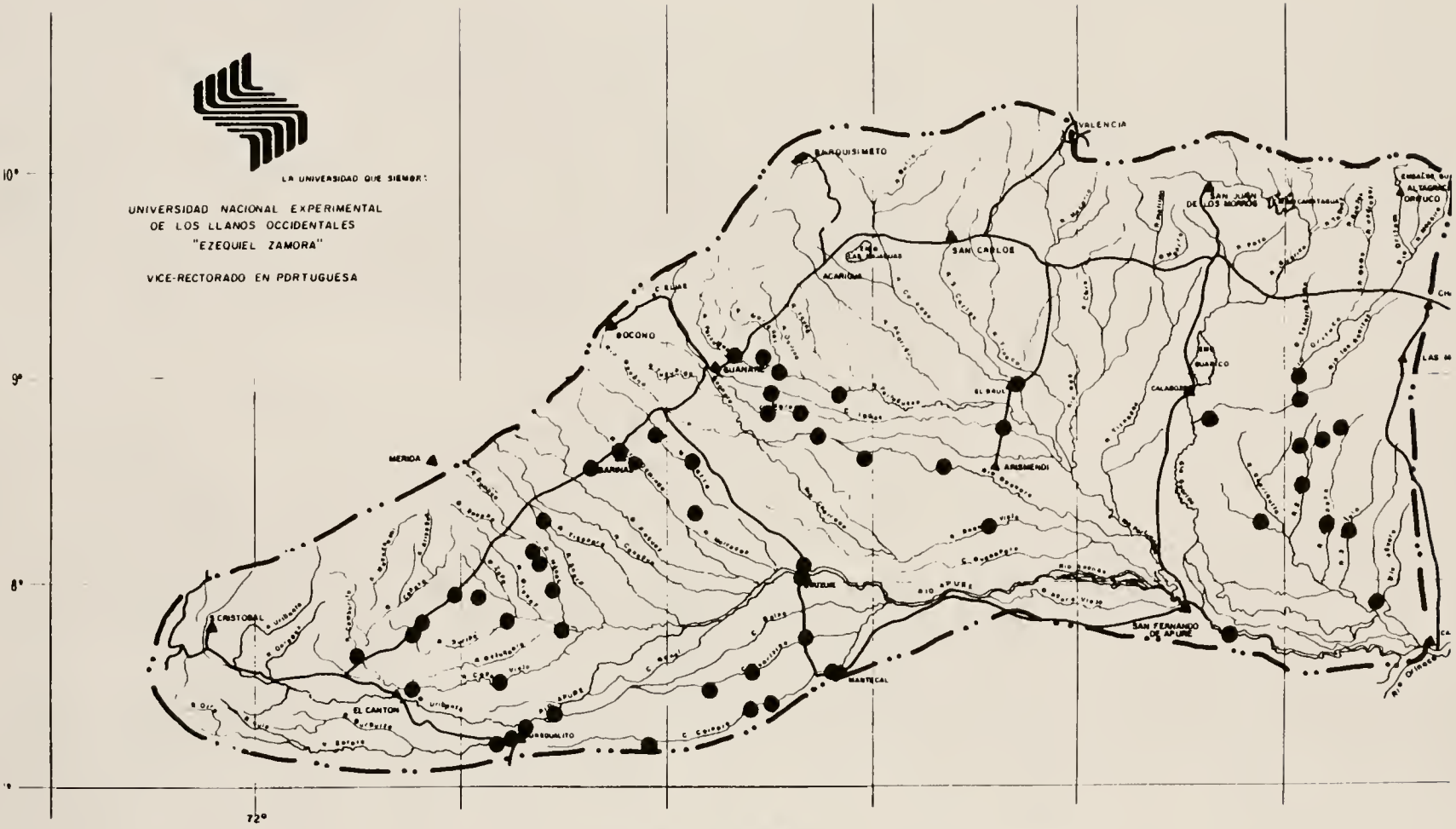
Size. This is a small fish that seldom exceeds 60 mm SL.

Morphology. This monotypic genus is characterized by having teeth on the ectopterygoid bone, a very elongate body and a complete lateral line. The anal fin is long and broad, the dorsal fin is set very far back on the body. The base of the anal fin has a sheath of scales.

Counts. DR ii8; AR 61-68; PR i12; VR i5; LLS 49-51; TS 13; maxilla, premaxilla and dentary each with a single row of small tricuspid teeth.

Pigmentation. It is mostly transparent in life, but turns pale white or yellow in preservative. The occiput, first rays of the pectoral fin, the basal part of the first dorsal rays, and a median stripe through the center of the caudal peduncle and caudal fin, are all darkened with crowded melanophores (Myers 1942).

Figure 231. Apure drainage distribution of *Xenagoniates bondi*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It occurs in Venezuela and Colombia, probably throughout the Orinoco Basin.

Apure distribution. Map: fig. 231. It is found throughout the llanos and lower Andean piedmont.

Habitat. It inhabits the slower moving sections of streams and rivers of the low and high llanos, up to the piedmont region, and occurs in both white and blackwater biotopes.

Abundance. COMMON.

Number of specimens examined. 574 from 87 collections.

Food. These fishes nip pieces of fins from other fishes.

Reproduction. Strategy: rl. It has a very long extended ovary which extends back to the end of the anal-fin base, below and between the tips of the ribs. Eggs are visible through the transparent body wall.

Importance. It is sometimes sold as an ornamental, but its fin-nipping habits make it unpopular.

Unidentified

Fig. 232. Map: fig 233. Couplet 11b.

Comments. This fish superficially resembles species of the glandulocaudine genus Prionobrama, which has not yet been recorded from the Orinoco Basin. Prionobrama, however, has only one row of premaxillary teeth, vs two in this fish. I suspect it may be a Hemigrammus, but has the dorsal fin farther back than most species of that genus.

Description

Illustrations. Fig. 232.

Diagnosis. This fish resembles Gephyrocharax valenciae, but that species has the dorsal fin placed far posterior to the anal-fin origin.

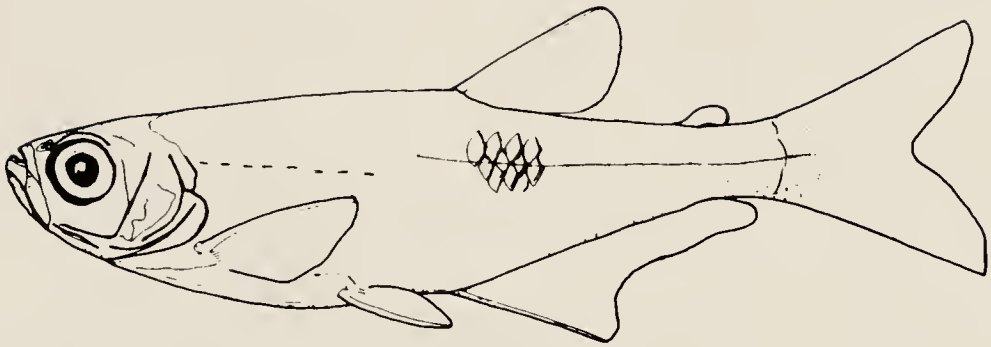


Figure 232. Unidentified.

In this unidentified species, the anal-fin origin is almost directly under the dorsal-fin origin. In Hemigrammus species, the dorsal-fin origin is anterior to the anal-fin origin.

Size. It reaches about 25 mm SL.

Morphology. The mouth is oblique, and nearly superior, with the maxilla in a nearly vertical position. The dorsal profile is straight, as in Gephyrocharax valenciae. The lateral line is incomplete. The pectoral fins are set quite low.

Counts. DR 9; AR 25-26; PR 10; VR 7; LS 32-34.

Pigmentation. There is a line of melanophores along the dorsal midline. The area above the anal fin also has scattered dark dots. Otherwise it is plain. In live specimens, the body is silvery to bluish and the tail is pink to red.

Distribution and Natural History

Range. It has been taken only from the upper Río Orituco and the neighboring Río Unare drainage.

Apure distribution. Map: fig. 233. It is known only from the northeasternmost corner of the Apure drainage, in the Orituco system.

Habitat. The Río Orituco is a muddy-bottomed river, that is reduced to isolated pools in the dry season.

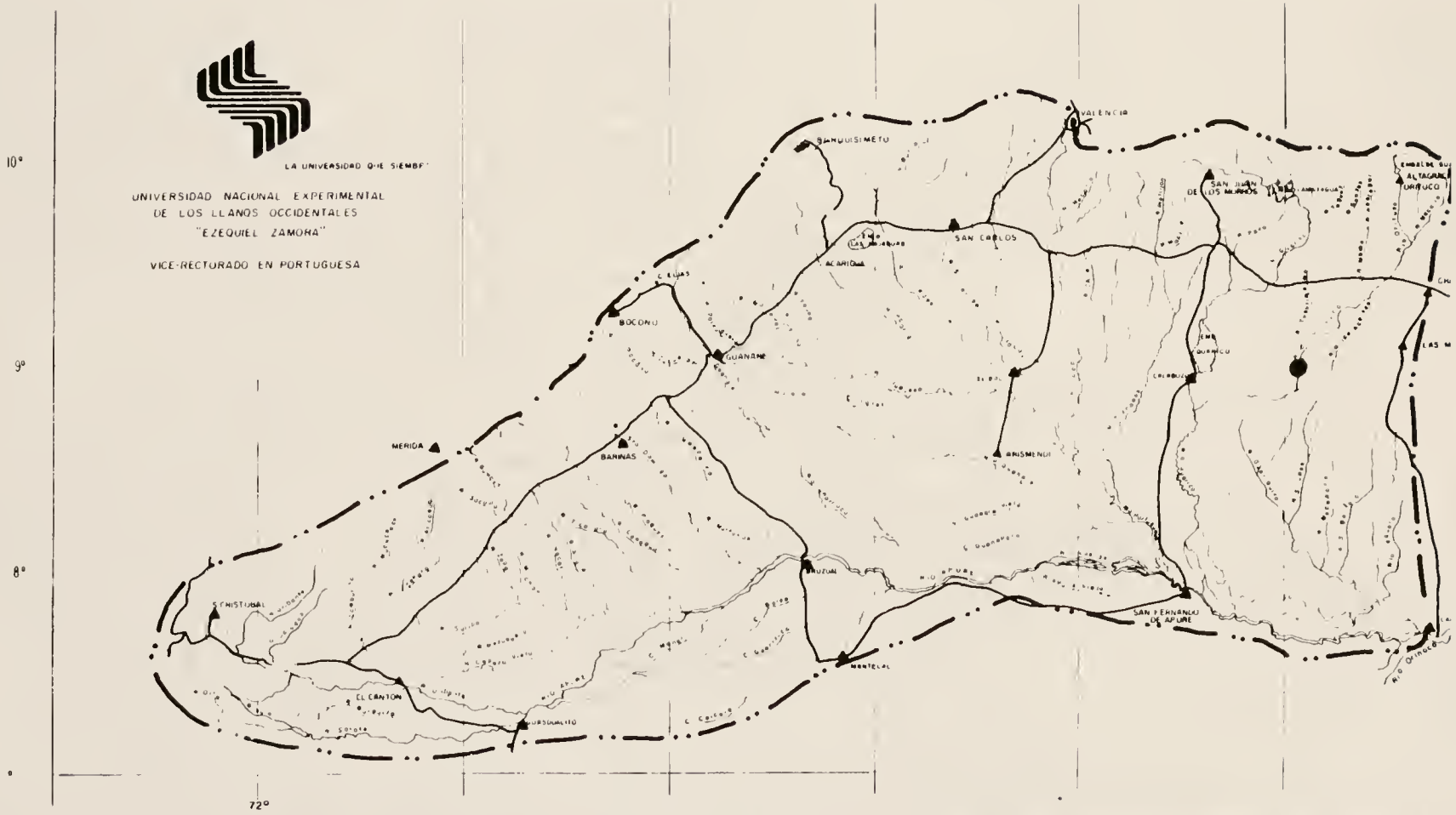
Abundance. RARE. This species is abundant where it occurs.

Number of specimens examined. 219 from one site.

Food. OMNIVORE. It probably feeds on aquatic insects, small seeds, microcrustaceans and other small invertebrates.

Reproduction. Strategy: rl. It is probably and egg scatterer that synchronizes reproduction with the onset of the rainy season in May or June, as is true of most small characids.

Figure 233. Apure drainage distribution of an unidentified characid.



CUENCA DEL RIO APURE

Characidiidae

Members of this family are ecological equivalents of the darters of North America. They are all small, benthic micro-carnivores, well adapted to life in the current, among rocks, gravel or sand. The pectoral fins and often the pelvics are enlarged, with the anteriormost rays thickened for added strength, and the chest flattened to give maximum contact with the substrate, which allows these fish to appress themselves closely in order to avoid the rush of the current. The snout and head are narrow and pointed. The entire body is hydrodynamically designed for little resistance to flow. Some species bury themselves in the sand.

Species of Characidiidae are remarkably uniform in morphology, and many species differ only slightly in outward appearance. As a result, for many years almost all Characidium were automatically referred to the species C. fasciatum. The work of Travassos in Brazil (eg. 1967) has revealed much more diversity. Géry (1977) estimated about "50 or more" species for the family.

The correct taxonomic rank of the Characidiidae is still unclear. Schultz (1944b) included them along with most other characoids in the family Characinidae. Weitzman (1962) still recognized only one family, the Characidae. The group was split into 16 families by Greenwood et al. (1966) but no specific mention of the genus Characidium and its relatives was made. Mago L. (1970) included seven Venezuelan species in the family Lebiasinidae, but Weitzman and Cobb (1975) did not include Characidium and relatives in that family. Weitzman & Kanazawa (1976) stated that the subfamily Characidiinae is of uncertain family affinities, tentatively assigned it to the Characidae, and rejected Géry's

(1971) recognition of the Characidiidae (with the subfamilies Characidiinae, Elachocharacinae and Geisleriinae). Weitzman & Géry (1981) "tentatively" recognized Characidiinae as a characid subfamily, but rejected Geisleriinae and Elachocharacinae as junior synonyms. Weitzman (1986) continues to describe new species as members of the family Characidae. I have recognized the group at the family level because I believe the morphological and ecological characters that unite them as a group will prove sufficient to separate them from the other families of Characiformes.

Mr. Paulo Buckup, a Brazilian ichthyologist working with Dr. William Fink at the University of Michigan, is currently revising the family and will undoubtedly increase the known number of species. He has generously provided me with his preliminary key to the Venezuelan species and has also verified or corrected many of my identifications. I have adopted his species identifications and codes. The species are out of alphabetical order in the species account because I have preserved the original order based on different (my) code names and species identifications.

Though little is known about characidiid reproductive biology, they probably are r2. Work done on the most common species in the piedmont suggests that they attain sexual maturity in about 11 months, and that reproduction is repeated throughout the first 4-5 months of the wet season and longer if conditions are favorable (Winemiller & Taphorn 1989). Hoedeman (1975) reported that "Characidium fasciatus scattered its eggs amongst aquatic plants near the bottom in an aquarium. Some North American darters display spectacular nuptial colors, and deposit small numbers of eggs under rocks, which are then guarded. South American darters might be expected to show similar adaptations.

Key to the Species of Characidiidae in the Apure River Drainage.

1a. Dorsal fin with fewer than twelve rays... ...2

1b. Dorsal fin with more than 16 rays...*Elachocharax* (2 spp.) ...11

2a. (1a) Mouth ventral (fig. 234a); body very elongate, its maximum depth about 12% SL; maxilla with up to ten teeth; snout very elongate and narrow... *Ammocryptocharax elegans* (fig. 235)

2b. Mouth terminal or subterminal (fig. 234b & c); body deeper, its maximum depth greater than 17% SL; no maxillary teeth; snout deeper and less pointed... ...3

3a. (2b) Caudal fin with distinct vertical bars, sometimes formed by rows of spots; first four pectoral-fin rays unbranched; body very dark (black or dark brown), with numerous spots and blotches... *Characidium* sp. D (fig. 239)

3b. Caudal-fin not vertically barred, sometimes with a basal spot or central rays darker or with spots not forming distinct bars; first three (or fewer) pectoral-fin rays unbranched; body pigmentation variable, but never dark brown or black... ...4

4a. (3b) Area between the pectoral-fin bases naked, abdomen scaled... *Characidium voladorita* (fig. 251)

4b. Both the area between the pectoral-fin bases and the abdomen scaled... ...5

5a. (4b) Sides without well-defined black vertical bars, a horizontal row of dark dots or small irregularly arranged crescent-shaped marks down midside often present, but these never forming distinct vertical bars along sides; dorsum crossed by narrow brown saddles that do not continue on sides; lateral line incomplete... ...6

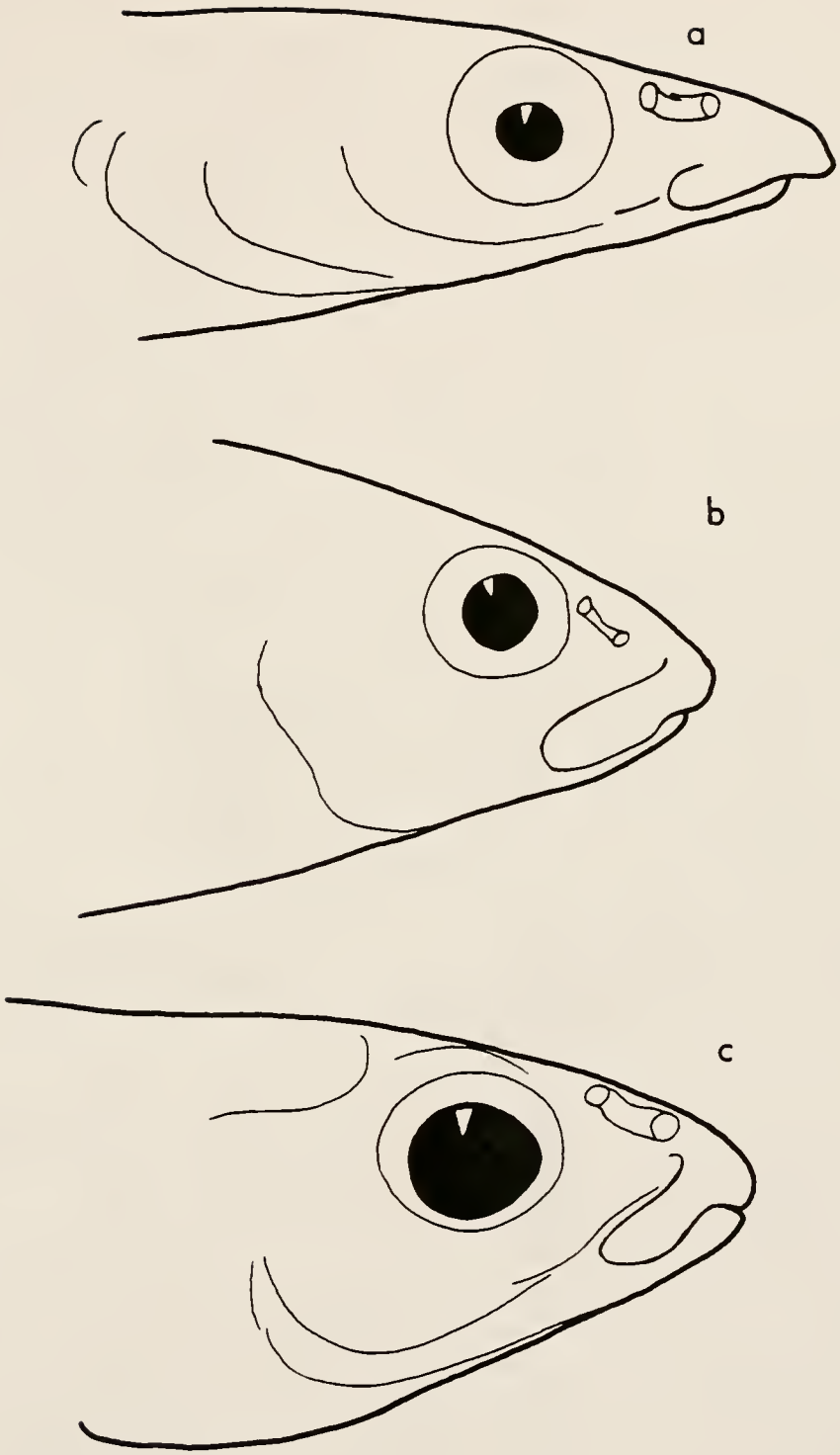


Figure 234. Mouth position in Characidiidae.
a. Ventral mouth position.
b. Subterminal mouth position.
c. Terminal mouth position.

5b. Sides with distinct vertical bars; a dark lateral stripe sometimes present; dorsum without brown saddles; lateral line variable.....7 (Note: In large adults of some species the vertical bars may be obscured by dark pigmentation, at least during the reproductive season, but smaller individuals should show this characteristic at all times.)

6a. (5a) Middle of sides with horizontal row of black spots; gape even with or above a horizontal line from along ventral edge of eye (fig. 1c); body heavily pigmented with tiny chromatophores that give a dusky background color in preservative; usually seven pectoral rays; greatest body depth 20% SL; head length 17% SL; interorbital width 40% HL... Characidium sp. K (fig. 243)

6b. Sides with irregularly arranged small brown crescents; gape below a horizontal line from along ventral edge of eye (fig. 1b); body nearly immaculate except for light brown crescents on sides; 8-10 pectoral rays; body more elongate, its greatest depth about 16% SL; head length 25% SL, interorbital 30% HL...

Characidium sp. J (fig. 245)

7a. (5b) Pectoral rays 12-15 ... Characidium chupa (fig. 241)

7b. Pectoral rays eleven or fewer... ...8

8a. (7b) Eye larger, about 49% of head length; vertical bars thin, more or less irregularly spaced and twelve or more in number...

Characidium sp. G (fig. 249)

8b. Eye smaller, 28-39% of head length; vertical bars wider and usually eleven or fewer in number, better defined, more evenly spaced... ...9

9a. (8b) Lateral line incomplete, with fewer than ten pored scales; pectoral rays nine or fewer, usually only seven, the first two extended as long filaments; dorsal-fin with a black spot near anterior base; pectoral-fin with a black basal spot; body deeper, its depth less than 3.6 in SL...

Characidium sp. H (no figure)

(Note: This is a rare, dwarf species, reaching only 20 mm SL; its pigmentation is quite similar to Elachocharax spp.; because it was recognized too late, it is not included in the species accounts)

9b. Lateral line complete, though sometimes difficult to see; pectoral rays usually eleven or more, the first not filamentous; dorsal-fin without spot at anterior base; pectoral-fin without black basal spot; body more slender, its maximum depth four or more in SL...10

10a. (9b) Only 2-4 short fat gill rakers on lower limb of outer arch; mouth subterminal, the gape located below a horizontal line drawn through ventral margin of eye (fig. 234b); a few melanophores on dorsal fin, some on membranes, most on outer tips of rays; no concentration of pigment behind eye; at least some of the teeth tricuspid; lateral scales 30-36; head length 15-18% of standard length; interorbital width 47-55% of head width...

Characidium cf catenatum (fig. 247)

(Note: There are probably two very similar species keying here, one with fewer lateral-line scales (30-33 vs 34-36), and a shorter, wider head (HL 15% SL vs 18%, IO 55% HL vs 47%.)

10b. About eight thin elongate gill rakers on lower limb of outer arch; mouth terminal, the gape in line with or above horizontal line through ventral margin of eye (fig. 234c); dorsal fin pigmented, with a bar through central portion and many spots along outer

third of rays; a concentration of dark pigment behind eye; teeth conical, or with tiny basal lateral cusps; head length 24% SL; IO 37% HL... Characidium cf zebra (fig. 237)

11a. (1b) Adipose fin absent; 16-17 interrupted vertical bars on body; all premaxillary teeth conical...Elachocharax junki (fig. 253)

11b. Adipose fin present; 8-10 wide vertical bars on body; some anterior premaxillary teeth tricuspid...

Elachocharax pulcher (fig. 255)

Species Accounts.

Ammocryptocharax elegans Weitzman & Kanazawa 1976

Voladorita Verde - South American Grass Darter

Fig. 235. Map: fig. 236. Couplet 2a.

Generic synonymy

Ammocryptocharax Weitzman & Kanazawa 1976 (type species: Ammocryptocharax elegans, by original designation).

Specific synonymy

Ammocryptocharax elegans Weitzman & Kanazawa 1976: 325-346 (type locality, Colombia, State of Meta, Vichada river drainage, Caño Muco about 15 km west of Puerto Gaitán toward Puerto Carreño), seen.

Types. Holotype: at USNM. Paratypes FMNH. No specimen numbers were given in the original description. Ibarra and Stewart (1987) unfortunately did not include catalog numbers of paratypes.

Etymology. AMMOCRYPTOCHARAX is a combination of the names Ammocrypta, a genus of North American darters, and Charax a genus of South American characid fishes, in reference to the superficial similarity between Ammocryptocharax and Ammocrypta; ELEGANS = is from the Latin

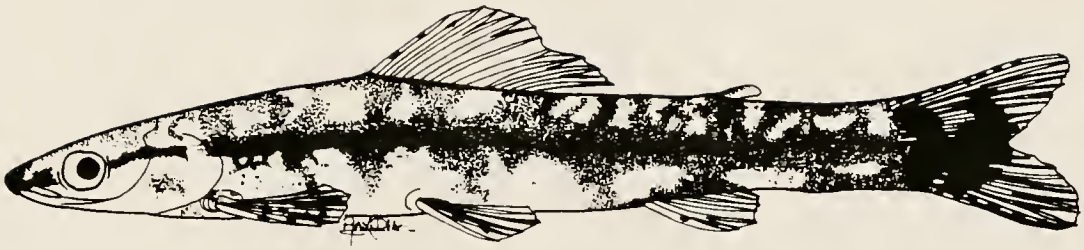


Figure 235. Ammocryptocharax elegans.

meaning special, choice, fine, or select (Weitzman & Kanazawa 1976).

Description

Illustrations. Figs. 234a (head) & 235; Weitzman & Kanazawa 1976:332, fig 1., 334, fig. 2.

Diagnosis. The strictly inferior mouth is unique to this species among Apure drainage characidiids. It is also the most elongate and slender member of the group with a greatest body depth of only 12% SL, versus almost always 17% or greater in the other species.

Size. It can reach at least 40 mm SL.

Morphology. The body is pencil-shaped and very elongate. The head is conical and the snout is very pointed and elongated. The snout length is greater than the horizontal diameter of the eye. The fins are not as enlarged as in mos *Characidium* spp. The teeth in *Ammocryptocharax* are all conical, and are arranged in only two rows on the dentary (Weitzman & Kanazawa 1976).

Counts. DR 10-12, usually ii9; AR 9, usually ii7; CR 19, 17 branched; PR 7-10 usually ii-6-i; VR 5; LLS 39-41; TS 8, 4 above, 3 below lateral line; 12 circumpeduncular scales.

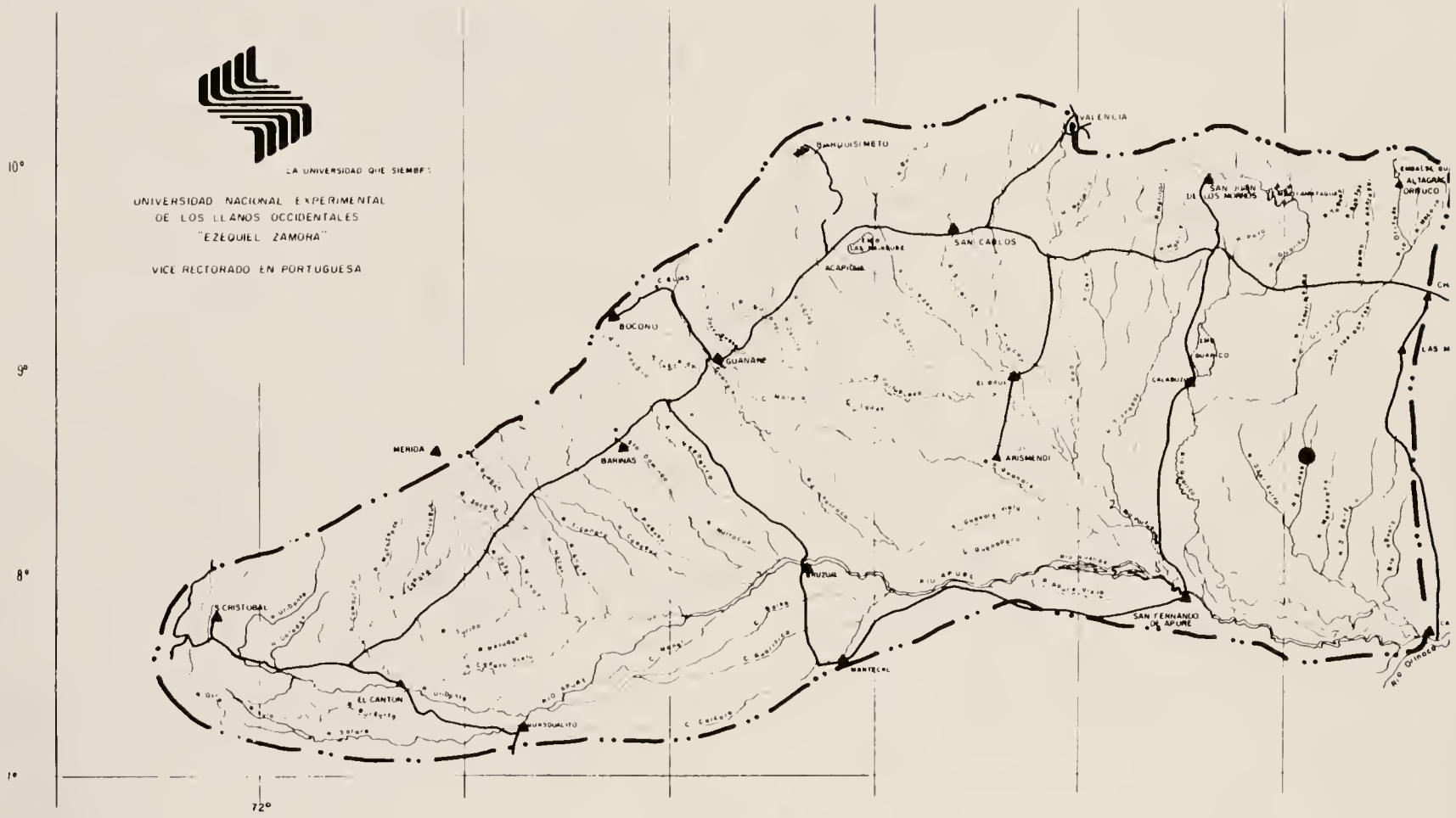
Measurements. See original description for details, the following measurements are from the Apure specimen: GBD/SL 0.12; EYE/HL 0.36; HL/SL 0.17; IO/HL 0.31; CPD/SL 0.07 (mean % values).

Pigmentation. Although the single Apure drainage specimen captured was bright grass green, I have collected two color phases from the Guyana Shield populations green and mottled cryptic brown.

Distribution and Natural History

Range. It is known from the Orinoco Basin, the Guaporé River along Brazilian and Bolivian border, and the main course of the Amazon River in the state of Pará, Brazil (Weitzman & Kanazawa 1976).

Figure 236. Apure drainage distribution of *Ammocryptocharax elegans*.



CUENCA DEL RIO APURE

Apure distribution. Map: fig. 236. This species is known only from the far southeastern corner of the drainage.

Abundance. RARE.

Number of specimens examined. 1.

Food. BENTHIC OMNIVORE. It probably feeds on aquatic insects.

Habitat. The specimen taken during this study was found in a blackwater stream in lowland savannas where there was abundant aquatic vegetation and a moderate current. Green specimens are always found in bright green grass (probably a sedge). They will change to a darker green, or lose the green color entirely when kept in surroundings of colors other than bright green. Brown specimens are always found among sticks and twigs. Brown specimens placed in bright green grass did not change colors.

Importance. Ornamental.

Characidium cf zebra Eigenmann 1909

Voladorita or Majuca - South American Darter

Fig. 237. Map: fig. 238. Couplet 10b.

Generic synonymy

Characidium Reinhardt 1866:55 (type species: Characidium fasciatum Reinhardt, by monotypy); Fowler 1950:253 (synonymy).

Chorimycterus Cope 1894:67 (type species: Chorimycterus tenuis Cope, by monotypy).

Nanognathus Boulenger 1895:3 (type species: Nanognathus borellii Boulenger, by monotypy).

Poecilosomatops Fowler 1906:323 (type species: Characidium etheostoma, by original designation).

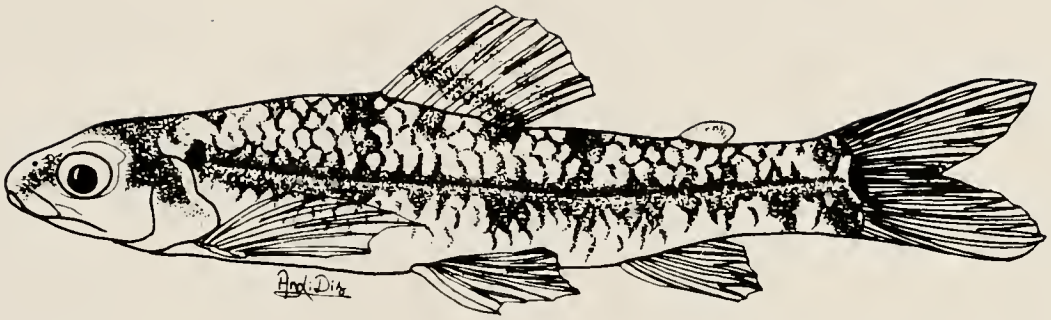


Figure 237. Characidium cf zebra.

Specific synonymy

Characidium zebra Eigenmann 1909:38 (type locality: Maripicru, a branch of the Ireng, in the upper Río Branco drainage, of northern Brazil, near the Venezuelan border, seen.

Types. Holotype: FMNH 53547 (formerly CM 1151). Paratypes: CM 1152-IU 11687 (6); CM 1159-IU 11687 (14). Ibarra & Stewart (1987) report that only seven paratypes remain at FMNH; CAS 60247(2) (IU 11680); CAS-SU 21775(1); 21910(1).

Etymology. CHARACIDIUM = presumably refers to a diminutive form of Charax.

Description

Illustrations. Fig. 237.

Diagnosis. This species is most similar to Characidium cf catenatum but has more gill rakers on the lower limb of the outer arch (8 vs 2-3) and has a strictly terminal mouth (subterminal in Ch. cf catenatum.

Size. It grows to about 50 mm SL.

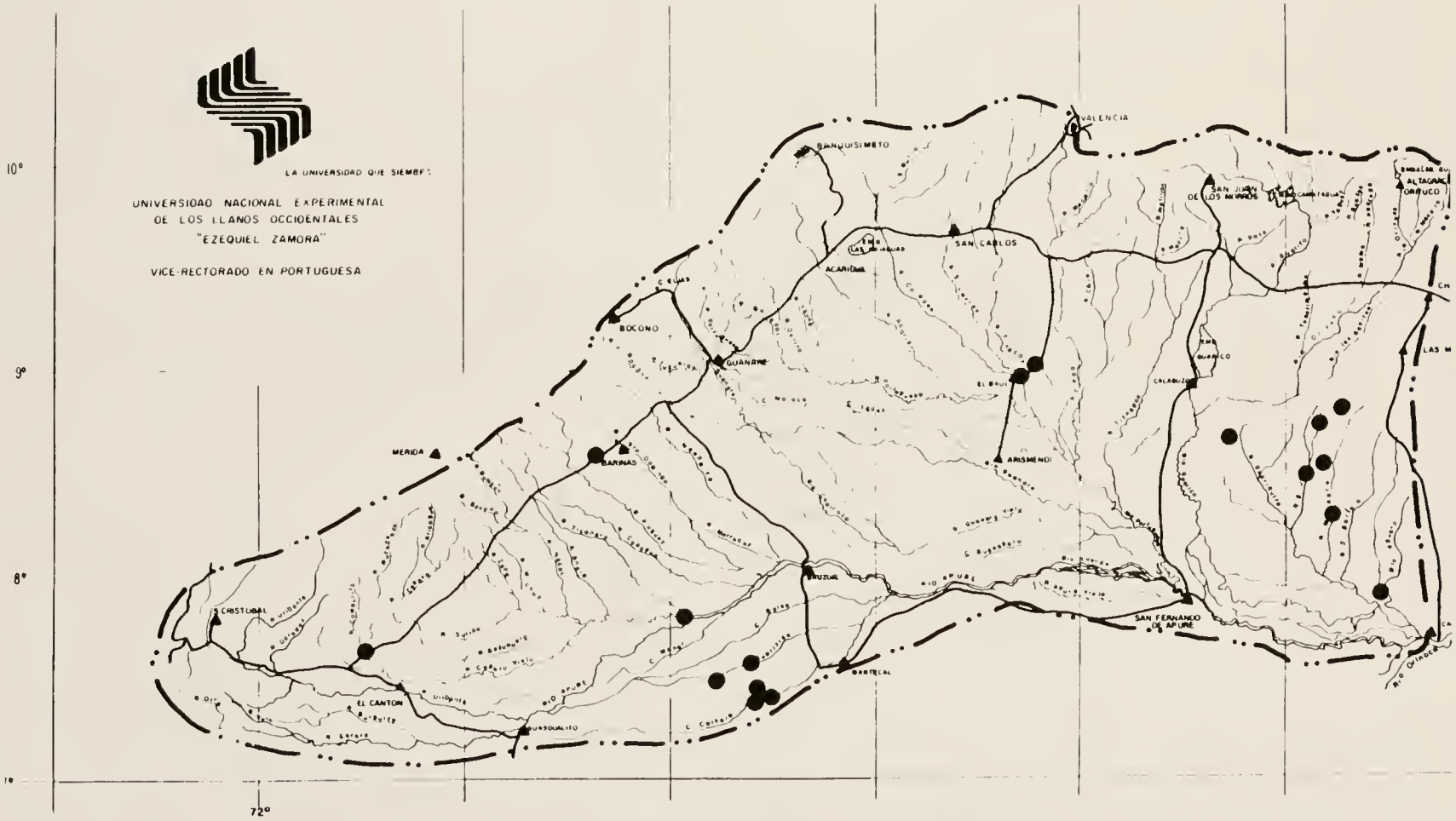
Morphology. The body is long and slender and the mouth terminal. The teeth are mostly conical, but sometimes have tiny, basal lateral cusps.

Counts. DR 9-11; AR 7-9; CR 17-20; PR 7-10, usually 10; VR 7-9, usually 9. (N=9).

Measurements. (N=9), given as percent of SL or HL as indicated: GBD/SL 17-23 (21); EYE/HL 27-35 (30); HL/SL 23-27 (24); IO/HL 29-49 (37); PDL/SL 39-48 (44); CPD/SL 10-13 (11).

Pigmentation. The basic pattern is a base color of light tan, crossed with dark vertical bars. There is a small black spot at base of the caudal fin.

Figure 238. Apure drainage distribution of *Characidium* cf *zebra*.



CUENCA DEL RIO APURE

Distribution and Natural History

Range. It is known from Guyana, Venezuela and northern Brazil (Río Branco).

Apure distribution. Map: fig. 238. This species is most common in northern Apure state, and in the Aguaro River system of the southeastern corner of the drainage.

Habitat. It inhabits blackwater streams of the lowland savanna. It can burrow into the sand to seek shelter.

Abundance. COMMON.

Number of specimens examined. 191 from 26 collections.

Food. BENTHIC OMNIVORE Its diet includes aquatic insects, especially chironomid larvae, microcrustaceans and algae.

Importance. Ornamental.

Characidium sp. D

Voladorita Negra - Black South American Darter

Fig. 239. Map: fig. 240. Couplet 3a.

Comments. This species is similar to Characidium crandelli Steindachner 1917, described from near Boa Vista, in the R. Blanco drainage, Brazil). It also resembles Ch. blennioides Eigenmann 1912, from Guyana. Géry (1977) distinguished between the two "species groups," stating that the Ch. crandelli group has only the first ventral (pelvic-fin) ray unbranched, whereas the Ch. blennioides group has the first two unbranched (at least on one side) and sometimes thickened.

Description

Illustrations. Fig. 239.

Diagnosis. This is the only dark Characidium in the Apure drainage that is dark brown to black in overall pigmentation. In addition,

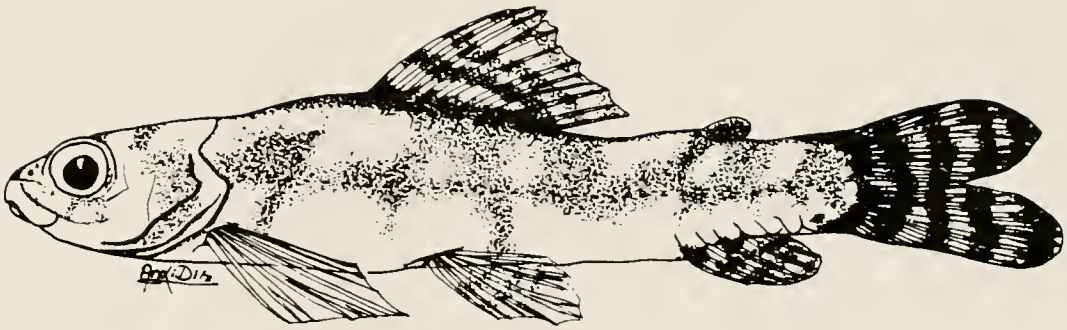
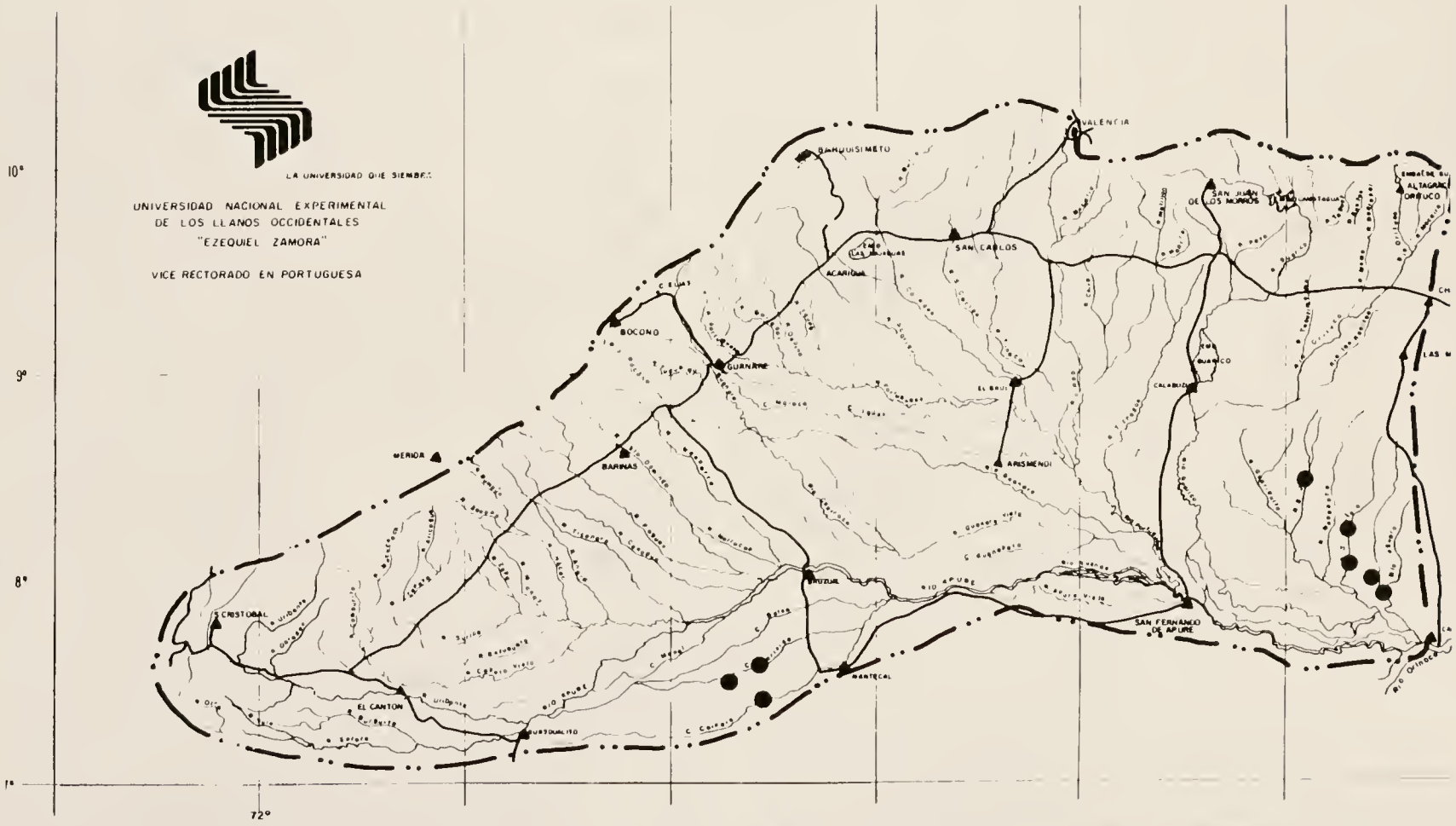


Figure 239. Characidium sp. "D".

Figure 240. Apure drainage distribution of *Characidium* sp. D



CUENCA DEL RIO APURE

the caudal fin has distinct vertical bars and the first four pelvic-fin rays are unbranched.

Size. It reaches about 40 mm SL.

Counts. DR 10-11; AR 7; CR 19; PR 10-13, usually 12; VR 8 (usually only the first one unbranched); LLS 28; TS above LL 3, (N=5).

Measurements. GBD 0.17; EYE/HL 0.35; HL 0.19; IO/HL 0.44; PDL 0.45; CPD 0.12. (N=5).

Pigmentation. It is very dark brown to black in life, with the tail conspicuously barred.

Distribution and Natural History

Range. It is known from the Amazon and Orinoco basins.

Apure distribution. Map: fig. 240. It has been taken only from northern Apure State and the Aguaro River system in the southeastern corner of the drainage.

Habitat. It lives in blackwater streams of the lowland savanna.

Abundance. UNCOMMON.

Number of specimens examined. 17 from 8 collections.

Food. Unknown, but probably a benthic omnivore.

Importance. Ornamental.

Characidium chupa Schultz 1944

Voladorita de Montaña - Andean Darter

Figs. 234b & 241. Map: fig. 242. Couplet 7a.

Specific synonymy

Characidium chupa chupa Schultz 1944b:284 (type locality for this subspecies: upper Río Chama, Maracaibo Basin), seen; Mago L. 1970:74.

Characidium chupa torbesensis Schultz 1944b:286 (type locality for the subspecies Ch. chupa torbesensis: Río Torbes, 1 km above Táriba, Orinoco drainage), seen; Mago L. 1970:74.

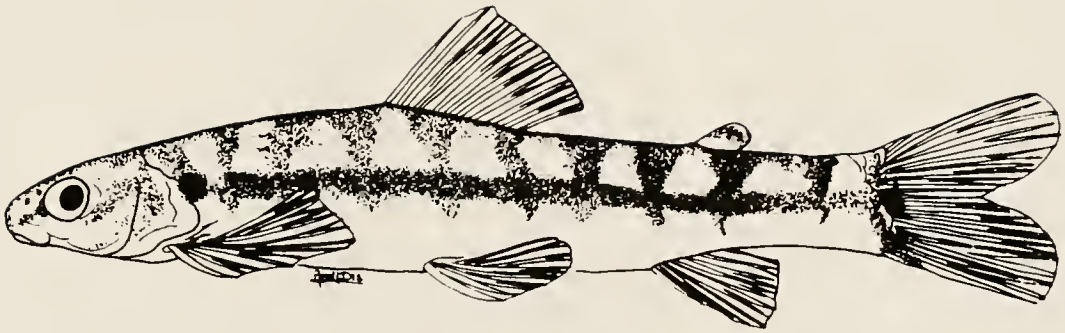


Figure 241. Characidium chupa.

Types. For the subspecies Ch. chupa torbesensis Holotype: USNM 121415. Paratypes: USNM 121416 (7). For the subspecies Ch. chupa chupa Holotype: USNM 121417. Paratypes: USNM 121418 (1), 121419 (80), 121420 (9).

Comments. Schultz (1944b) described both subspecies, Characidium chupa chupa from the upper Río Chama in the Maracaibo Basin, and Ch. chupa torbesensis from the Río Torbes near San Cristobal in the upper Apure drainage, Orinoco Basin, in the same paper.

Etymology. CHUPA = is a common name for this species in the Río Chama valley near Mérida.

Description

Illustrations. Figs. 234b & 241; Schultz 1944b:287, fig. 34.

Diagnosis. This species is characterized by a relatively high pectoral-fin ray count of 12-15.

Size. This is a large Characidium, reaching at least 80 mm SL.

Morphology. It is a robust, heavy-bodied fish when adult.

Counts. DR 10; AR 7-9; CR 18-20; PR 10-13, usually 12-13; VR 8-9; LLS 34-38; TS above LL 4-5. (N=5)

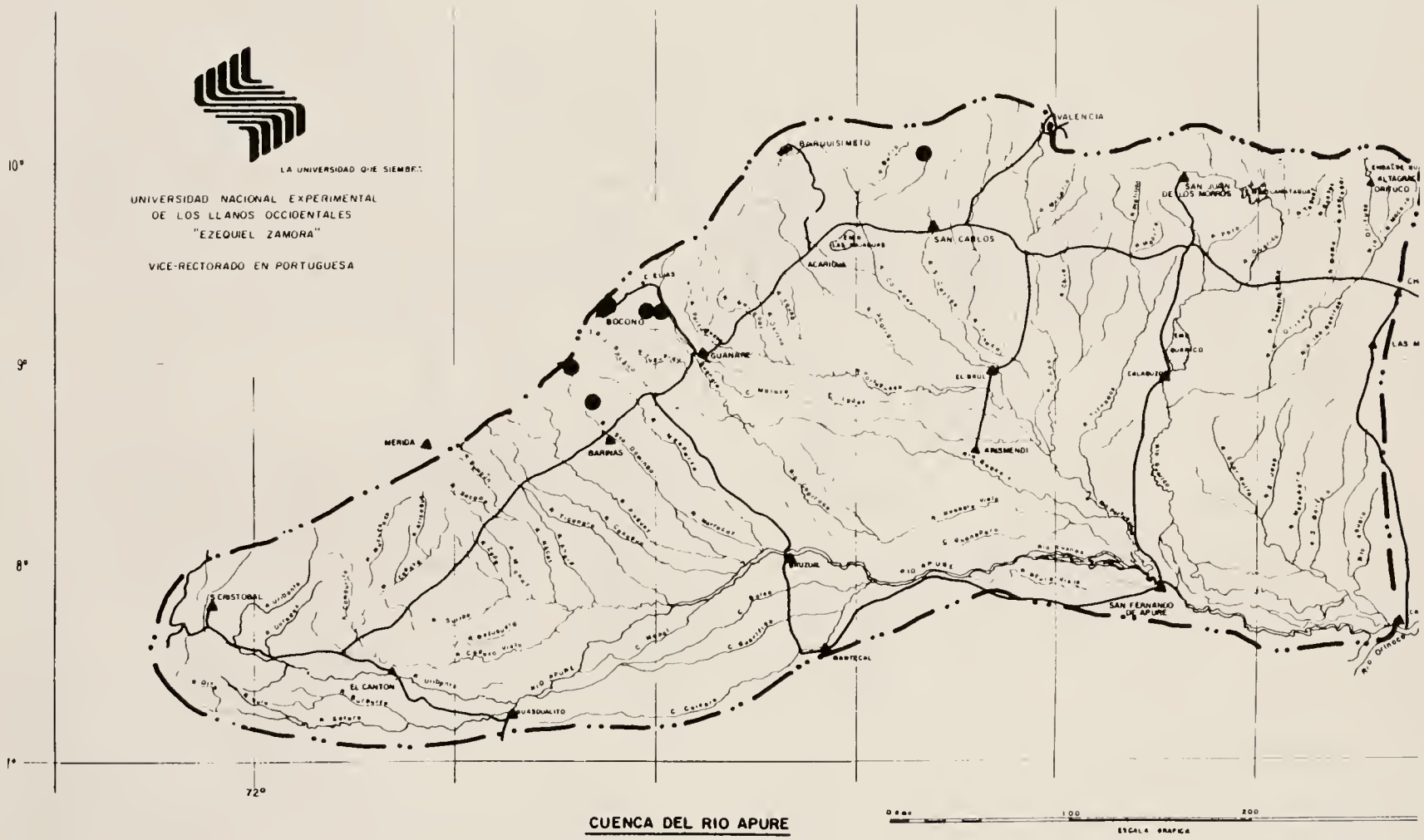
Measurements. GBD 0.21; EYE/HL 0.28; HL 0.17; IO/HL 0.44; PDL 0.43; CPD 0.12. (N=5).

Pigmentation. Schultz (1944b) gave the following description: The color bars extend below the blackish lateral band and are not enlarged into round blotches along the mid-axis as in C. chupa chupa. In life this species is brightly colored, with yellow spots on head and gills and yellow or orange on the fins.

Distribution and Natural History

Range. It is known from the Andes and Perijá mountains, of the Orinoco and Maracaibo basins.

Figure 242. Apure drainage distribution of *Characidium chupa*.



CUENCA DEL RIO APURE

Apure distribution. Map: fig. 242. In the Apure drainage this fish is restricted to the piedmont and montane streams of the Andes.

Habitat. It is found in clear water with moderate to rapid current over a rocky substrate in streams and rivers of the Andean piedmont and mountains.

Abundance. RARE.

Number of specimens examined. 9 from 7 collections.

Food. BENTHIC OMNIVORE. Its diet includes aquatic insects, especially chironomid larvae, microcrustaceans and algae (pers. com. Alex Flecker).

Reproduction. Though no field observations are available, the bright colors of adults suggest some sort of courtship ritual.

Importance. Ornamental.

Characidium sp. K

Voladorita Transparente - Transparent South American Darter

Fig. 243. Map: fig. 244. Couplet 6a.

Comments. This species is similar to *Characidium pellucidum* Eigenmann 1909 from Guyana.

Description

Illustrations. Fig. 243.

Diagnosis. This species is characterized by the following combination of characters: the middle of the side is marked with a horizontal row of black spots; the gape is even with or above a horizontal line from along ventral edge of eye (fig. 1C); there are usually only seven pectoral-fin rays; the greatest body depth is about 20% SL; the head is relatively long, its length about 17% SL; the interorbital width is about 40% HL.

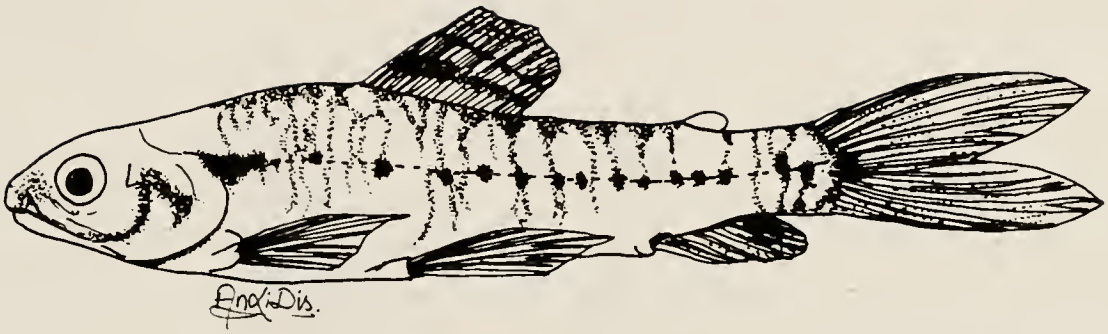
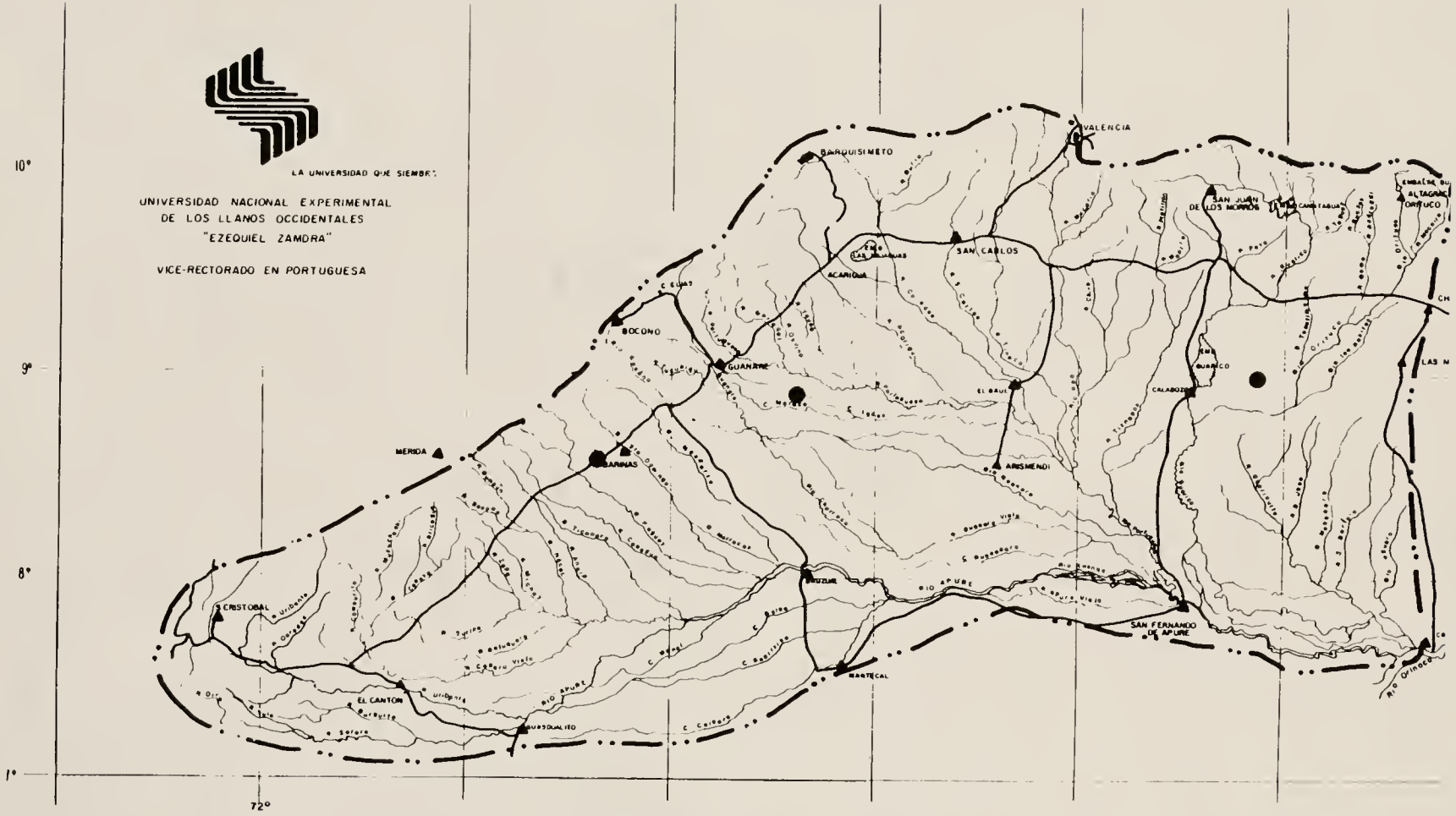


Figure 243. Characidium sp. "K".

Figure 244. Apure drainage distribution of *Characidium* sp. K.



CUENCA DEL RIO APURE

Size. This is a dwarf Characidium that seldom exceeds 40 mm SL.

Morphology. It is an elongate and slender-bodied Characidium, the head longer than in most species. The pectoral fins reach the ventrals, and the outer pectoral rays are not thickened.

Counts. DR 10-11; AR 7; CR 16-17; PR 7; VR 9; LS 30; TS above LL 4; (N =8).

Measurements. GBD 0.20; EYE/HL 0.34; HL 0.25; IO/HL 0.30; PDL 0.37; CPD 0.10.

Pigmentation. The body is transparent in life, but in preservative numerous tiny chromatophores give it a dusky tan background color. There is a row of irregular black spots down the middle of the sides.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 244. Collections are all from the high llanos.

Habitat. Few specimens have been collected, but this species has been found so far in whitewater streams with slow to moderate currents.

Abundance. RARE.

Number of specimens examined. 36 from 4 collections.

Food. Unknown but probably a benthic omnivore.

Importance. Ornamental.

Characidium sp. J

Voladorita Arenera - South American Sand Darter

Fig. 245. Map: fig. 246. Couplet 6b.

Comments. This species is similar to Characidium pteroides Eigenmann 1909, from Guyana.

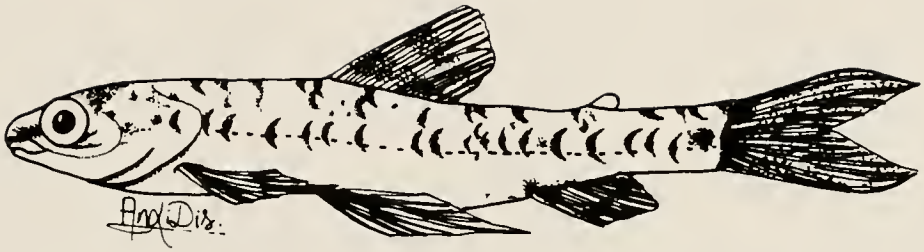


Figure 245. Characidium sp. "J".

Description

Illustrations. Fig. 245.

Diagnosis. This Characidium is characterized by its small size, an incomplete lateral line (but its scales are deciduous and usually lost), and a pigmentation pattern of a light background with light brown crescents on the sides. It lacks the dark vertical bars typical of most Apure drainage characidiids.

Size. This is a very small, dwarf Characidium that seldom exceeds 30 mm SL.

Morphology. It is elongate and slender, and well adapted to burrowing into the sand.

Counts. DR 8-11; AR 6-7; CR 15-19; PR 8-10; VR 6-9; LS 25-29; TS above LL 4. (N=7).

Measurements. GBD 0.16; EYE/HL 0.39; HL 0.17; IO/HL 0.40; PDL 0.41; CPD 0.11 (mean values), (N=7).

Pigmentation. The body is light tan with irregularly spaced light brown crescents along the sides.

Distribution and Natural History

Range. It occurs in Guyana and the Orinoco Basin.

Apure distribution. Map: fig. 246. It has been taken only from the Aguaro River system.

Habitat. It lives in blackwater lowland savanna streams, usually over white sand substrates.

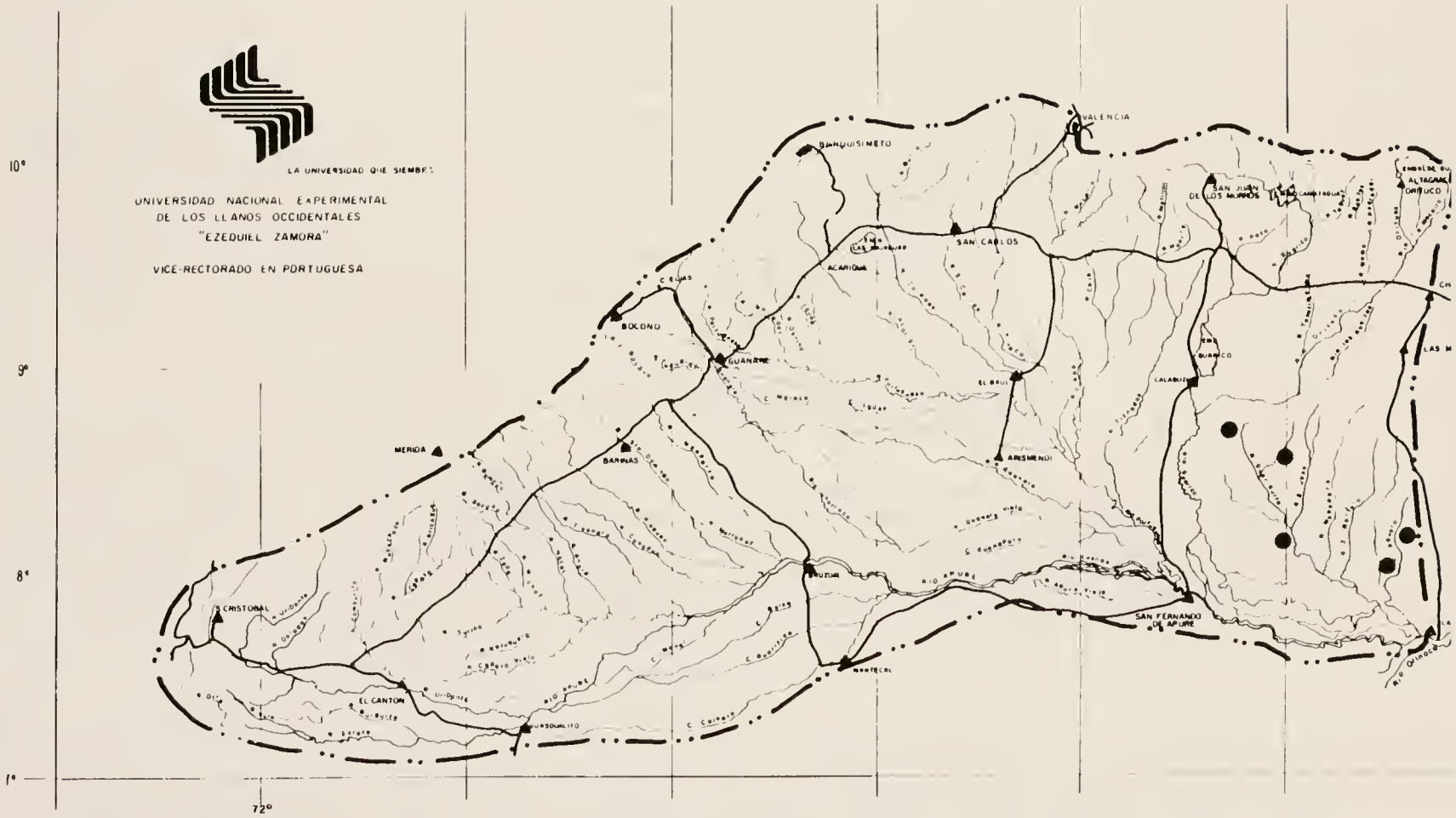
Abundance. RARE.

Number of specimens examined. 24 from 6 collections.

Food. Unknown, but it is probably a benthic omnivore.

Importance. Ornamental.

Figure 246. Apure drainage distribution of *Characidium* sp. J.



CUENCA DEL RIO APURE

Characidium cf catenatum Eigenmann 1909

Voladorita - South American Darter

Fig. 247. Map: fig. 248. Couplet 10a.

Specific synonymy

Characidium catenatum Eigenmann 1909:40 (type locality: Warraputa, Rockstone, Crab Falls, Guyana); Eigenmann 1920:10 (from Río Guaire near Caracas and Río Tuy in Concejo, Venez.), seen; Schultz 1944b:279.

Types. Holotype: FMNH 52761 (CM 1153). Paratypes: of the original paratypes CM 1154-IU 11681 (12 specimens) and CM 1155-IU 11682 (2 specs.) only 6 remain at FMNH (Ibarra & Stewart 1987).

Comments. There may be two species included here. The lateral-line scale counts seem to fall into two groups, and the distribution map indicates the possibility of separate highland and lowland populations.

Etymology. CATENATUM = chain, from Latin, referring to the chain-like pattern of the bars on the upper sides of this species.

Description

Illustrations. Fig. 247; Eigenmann 1912: pl. 38 (5-6).

Diagnosis. The subterminal mouth and low gill raker count (2-3) separate this species from other similarly pigmented Characidium in the Apure drainage.

Size. This is a medium-sized Characidium, reaching 45 mm SL.

Morphology. The mouth is distinctly subterminal.

Counts. DR 9-11; AR 6-8; CR 17-19; PR 8-11; VR 7-9; LLS 30-33 in some populations, 34-36 in others; TS above LL 4. (N=12).

Measurements. given as % SL or HL as indicated: GBD/SL 19; EYE/HL 33; HL/SL 17; IO/HL 55 in some populations, 47 in others; PDL/SL 44; CPD/SL 12. (N=12).

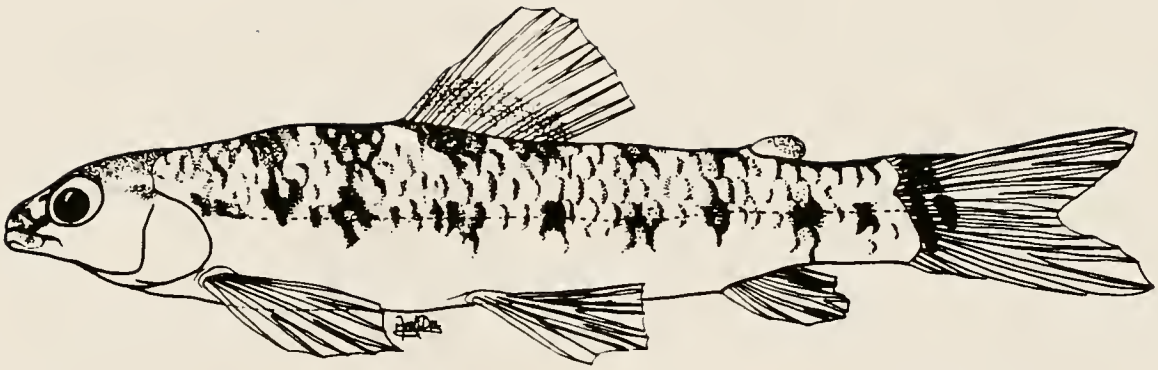
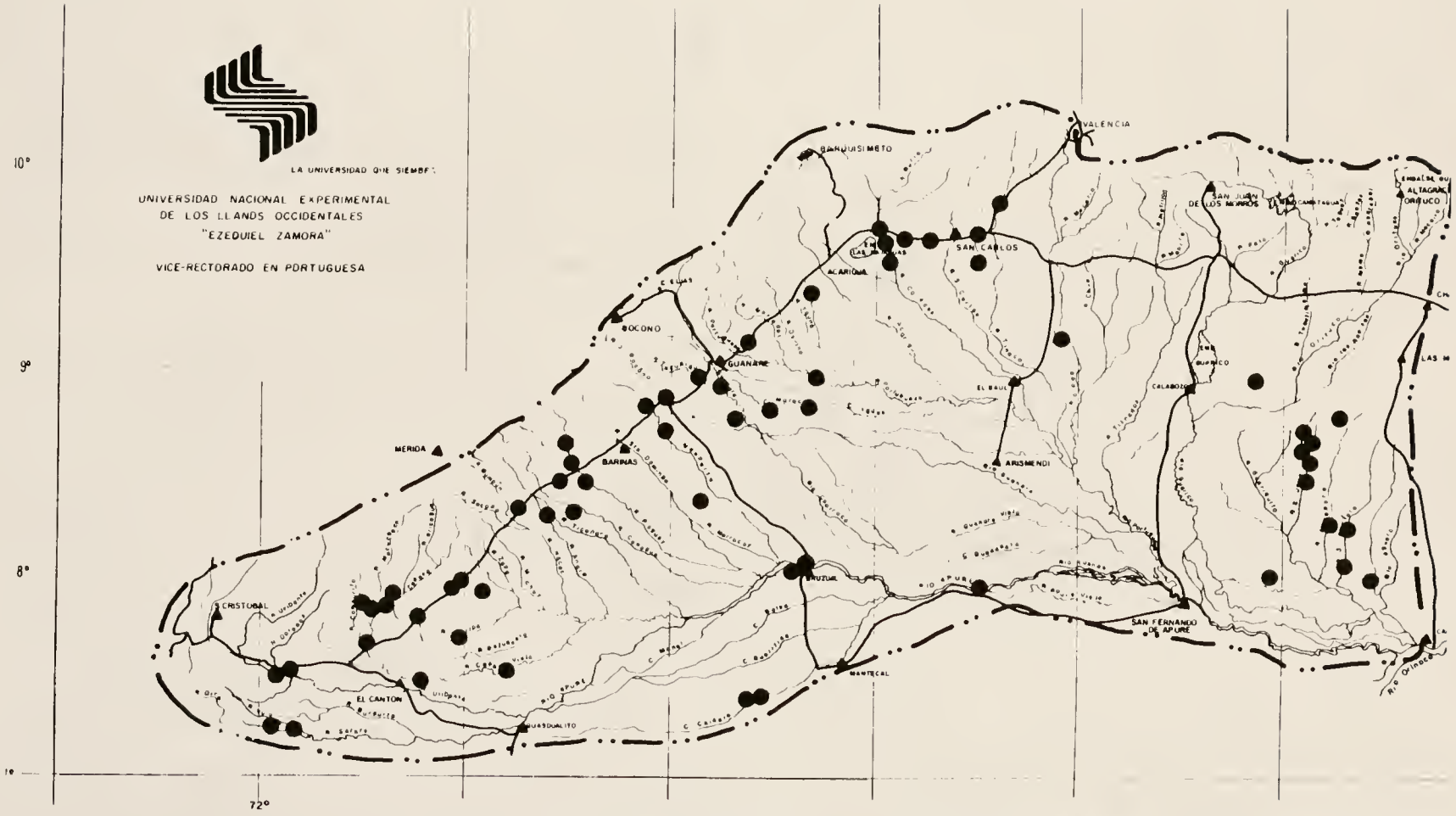


Figure 247. Characidium cf catenatum.

Figure 248. Apure drainage distribution of *Characidium* cf *catenatum*.



CUENCA DEL RIO APURE

Pigmentation. The body is whitish to light brown, with 9-10 black or brown vertical bars that are interrupted on midside. In addition to those bars, the sides have 4-5 horizontal rows of faint dots (one per scale). There is a dark black spot at the base of the caudal fin. A brown line extends from the eye to the tip of the snout.

Distribution and Natural History

Apure distribution. Map: fig. 248. There seem to be two separate populations, one in the piedmont and the other in low llanos. This separation could account for the different counts noted above, and is another indication that two species may be involved.

Habitat. It is known from a wide variety of lotic habitats, in both the piedmont and llanos.

Abundance. ABUNDANT.

Number of specimens examined. 389 from 82 collections.

Food. BENTHIC OMNIVORE. The diet includes aquatic insects (especially chironomid larvae), microcrustaceans and algae.

Importance. Ornamental.

Characidium sp. G

Voladorita - South American Darter

Fig. 249. Map: fig. 250. Couplet 8a.

Description

Illustrations. Fig. 249.

Diagnosis. Of all the Apure drainage *Characidium* species, this one has the shortest, deepest body. The eye is particularly large, its diameter comprises 49% of the head length. The pigmentation pattern is also distinctive, consisting of numerous thin vertical bars (more than in any other Apure drainage species).

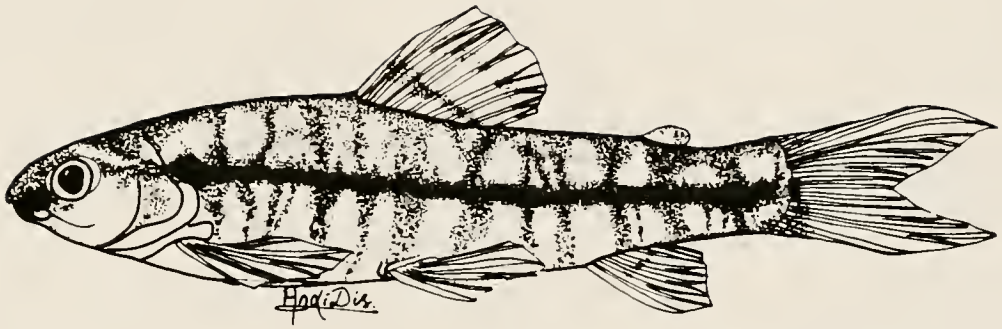


Figure 249. Characidium sp. "G".

Size. This small species seldom exceeds 30 mm SL.

Morphology. The body is short, high, and stocky. The head is wide, with a bluntly rounded snout.

Counts. DR 8-10; AR 7-9; CR 19; PR 9; VR 7-8; LLS 31-33; TS above LL 4, (N=7).

Measurements. given as % SL or HL as indicated: GBD/SL 22; EYE/HL 49; HL/SL 16; IO/HL 55; PDL/SL 43; CPD/SL 13 (mean values), (N=7).

Pigmentation. The base color of the body is light brown. There are 11-15 thin vertical bars on the sides, some of them double, and often united across the dorsum. Many specimens have additional thin, short, incomplete vertical bars in between the wider ones. The lateral midline has a dark stripe that extends from the tip of the snout back through the eye and onto the opercle. The base of the caudal fin is marked with a small black dot. A black line extends forward along the ventral midline from in front of the anal fin.

Distribution and Natural History

Apure distribution. Map: fig. 250. It is widespread throughout the llanos and piedmont.

Habitat. It lives in a wide variety of lotic habitats.

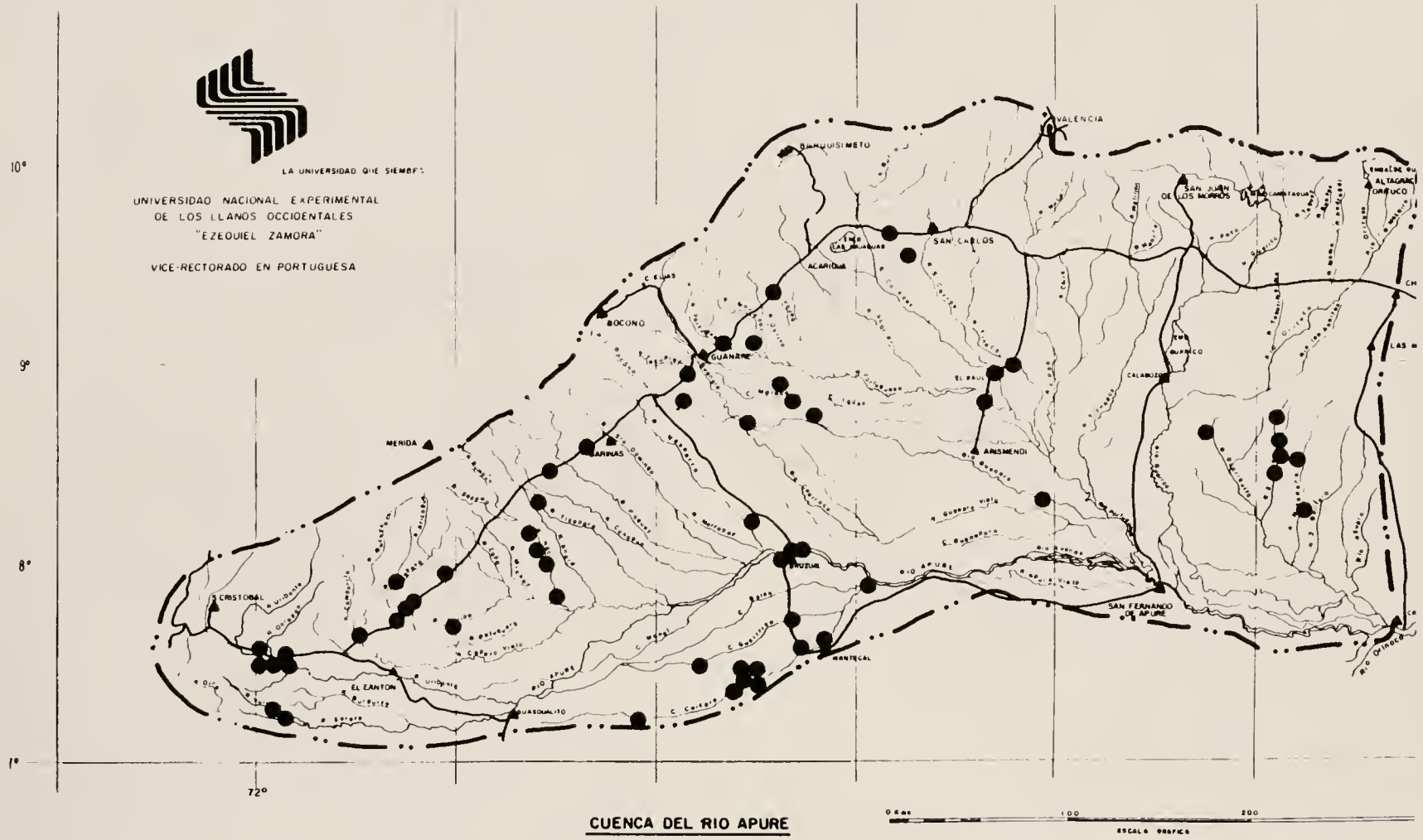
Abundance. ABUNDANT. This is the most common characidiid in the Apure drainage.

Number of specimens examined. 464 from 83 collections.

Food. BENTHIC OMNIVORE. Its diet includes aquatic insects, microcrustaceans and algae. I have observed this species in aquaria, hovering just beneath floating aquatic vegetation, staring intently at the surface for several minutes, then making a quick jab at some small (invisible to me) aquatic creature.

Importance. Ornamental.

Figure 250. Apure drainage distribution of *Characidium* sp. G.



CUENCA DEL RIO APURE

Characidium voladorita Schultz 1944

Voladorita - South American Darter

Fig. 251. Map: fig. 252. Couplet 4a.

Specific synonymy

Characidium voladorita Schultz 1944b:280, fig. 32 (type locality: 4 km above Motatán in the Río Motatán, Maracaibo Basin), seen; Mago L. 1970:74.

Types. Holotype: USNM 121407. Paratypes: USNM 121408 (40); 121409 (15); 121410 (27); 121411 (3); 121412 (10); 121413 (26); 121414 (96).

Comments. This species was originally described and hitherto known only from the Maracaibo Basin. I have not carefully compared Apure specimens with Maracaibo specimens, but the presence of Characidium species on both sides of the Andes is not unprecedented, as for example in the case of Ch. chupa

Etymology. VOLADORITA = the common name of this species in Spanish, meaning "little flyer." The name "volador" is given to Lebiasina erythrinoides a species frequently sympatric with Characidium in the Andes. The name "voladorita" means little volador, and is probably a result of the common but erroneous belief of rural people that all small fishes must be juveniles of some larger fish they know and use. Thus when Schultz asked for the name of this Characidium, they gave the diminutive form of the name for Lebiasina.

Description

Illustrations. Fig. 251; Schultz 1944b:280, fig. 32.

Diagnosis. This is the only species of Characidium in the Apure drainage with a naked area between the pectoral fins.

Size. It reaches about 45 mm SL.

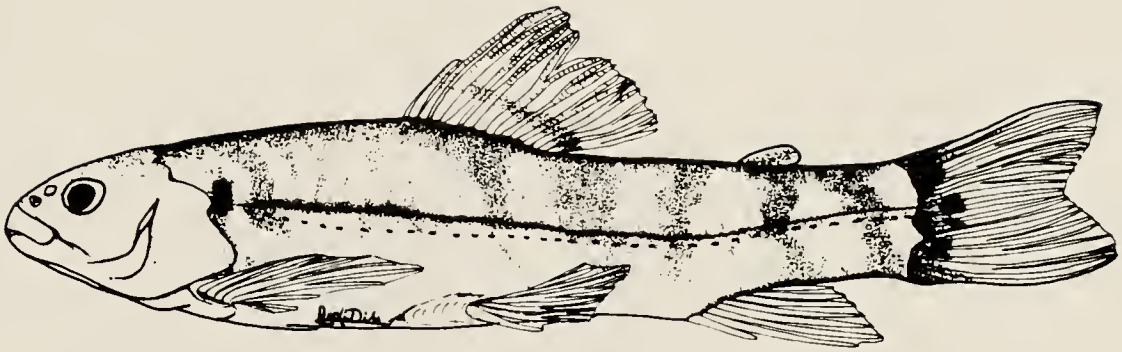


Figure 251. Characidium voladorita.

Counts. Schultz (1944b) gave the following for the Maracaibo population: DR iii8-iii9; AR iii6; PR iii8-iii9; VR i7; GR 5+10 on first arch; LLS 30-33; TS 3 1/2 above, 2 1/2 - 3 below; 10-12 predorsal scales. Apure drainage specimens usually fall into these ranges.

Measurements. GBD 22% SL; EYE 33% HL; HL 16% SL; IO 43% HL; PDL 45 % SL; CPD 13% SL (mean values).

Pigmentation. The live coloration is quite striking in the breeding season, when the males become brick red on the entire ventrum, rear portion of the body and tail. The dorsal fin is red and yellow, and the head is bordered posteriorly with a yellow band. In alcohol it is tan with darker vertical bars when young, but adults can lose the vertical bars almost completely. There is always at least a trace of a humeral spot just behind the opercle.

Distribution and Natural History

Range. It is known from the Maracaibo Basin, as well as in adjacent areas of the Andean piedmont in the Apure drainage. It probably also extends into the Colombian Andes.

Apure distribution. Map: fig. 252. This is the first record of this species in the Orinoco Basin. It is restricted to Andean streams and rivers.

Habitat. It occurs in Andean piedmont and montane streams with fast currents and rocky substrates.

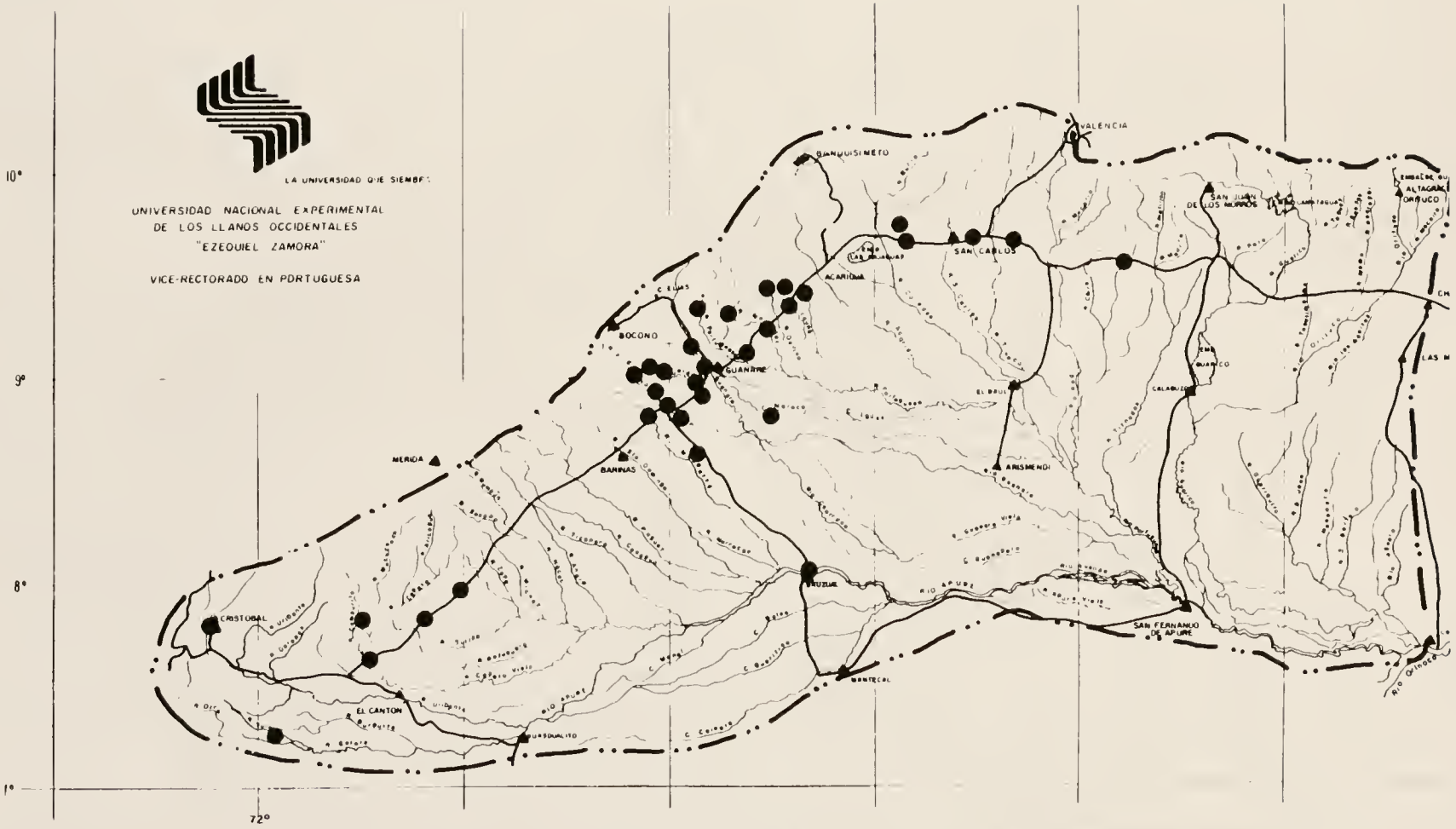
Abundance. COMMON.

Number of specimens examined. 302 from 46 collections.

Food. BENTHIC OMNIVORE. It feeds on aquatic insects, especially chironomid larvae, microcrustaceans and algae (Alex Flecker, pers. com.).

Importance. Ornamental.

Figure 252. Apure drainage distribution of *Characidium voladorita*.



CUENCA DEL RIO APURE

Elachocharax cf junki Géry 1971

Voladorita Enana - Dwarf South American Darter

Fig. 253. Map: fig. 254. Couplet 11a.

Generic synonymy

Elachocharax Myers 1927:114 (type species: Elachocharax pulcher Myers 1927), by monotypy; Géry 1977:122; Weitzman & Kanazawa 1978:160 (redefinition); Weitzman & Géry 1981:888 (revision).

Elacocharax Weitzman & Kanazawa 1976:328 (misspelling).

Geisleria Géry 1971:154 (type species Geileria junki 1971), by monotypy; Gery 1977:122.

Specific synonymy

Geisleria junki Géry 1971:154 (type locality: Brazil, Rondonia, Río Novo, tributary to Río Jamari about 45 km east of Porto Velho, Río Madeira basin; Géry 1977:122; (listed, brief comments); Weitzman & Kanazawa 1978:168 (relationships); Weitzman & Géry 1981:887 (key; redescription); Weitzman 1986:740 (key).

Types. Holotype: collection of J. Géry. Paratypes: MZUSP 14008 (1); and four specimens in the collection of J. Géry.

Etymology. ELACHO = insignificant, from the Greek, and CHARAX a genus of Characidae; JUNKI = to honor Dr. W. Junk of INPA in Manaus, Brazil.

Description

Illustrations. Fig. 253.

Diagnosis. This species is distinguished from all Characidium species by the possession of more than 16 dorsal-fin rays. It differs from Elachocharax pulcher by the lack of an adipose fin and the absence of tricuspid teeth on the premaxilla. Pigmentary features vary too much to be useful as diagnostic characters.

Size. It is a dwarf species seldom exceeding 20 mm SL.

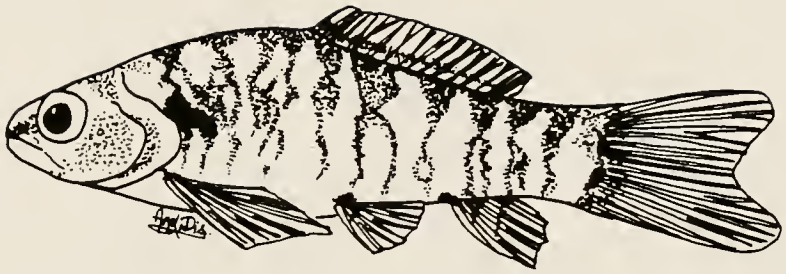


Figure 253. Elachocharax junki.

Morphology. This species has a short compressed body. The lateral line is incomplete. The anal-fin origin is at or slightly posterior to a vertical line drawn through the posterior termination of the dorsal-fin base (Weitzman 1986). The teeth in both jaws are all conical.

Counts. Teeth on ectopterygoid 4-5, on inner row of dentary 13-16; upper limb gill rakers 3; vertebrae 30-33; scales rows between anterior base of dorsal fin and pelvic fin 8; lateral scales 27-33 Weitzman 1986).

Measurements. Snout length about 6-8% SL. Caudal peduncle length about 16-19% SL (Weitzman 1986).

Pigmentation. Although this species is reported (Weitzman 1986) to have 13 to 14 narrow vertical dark bars in the caudal fin, most Apure drainage specimens do not show this pattern. The body is dark and crossed with vertical bars. The anal fin is marked with two strong black pigment bars, whereas the pelvic fin has only one.

Distribution and Natural History

Range. This species occurs in the upper Río Negro drainage in Brazil and Venezuela, in the Casiquiare Canal area, and in the upper Orinoco Basin in Venezuela (Weitzman 1986).

Apure distribution. Map: fig. 254. It is known only from the Aguaro River system.

Habitat. It lives in blackwater streams in the low llanos, usually in areas with aquatic vegetation, or with finely divided roots from terrestrial vegetation growing along the banks.

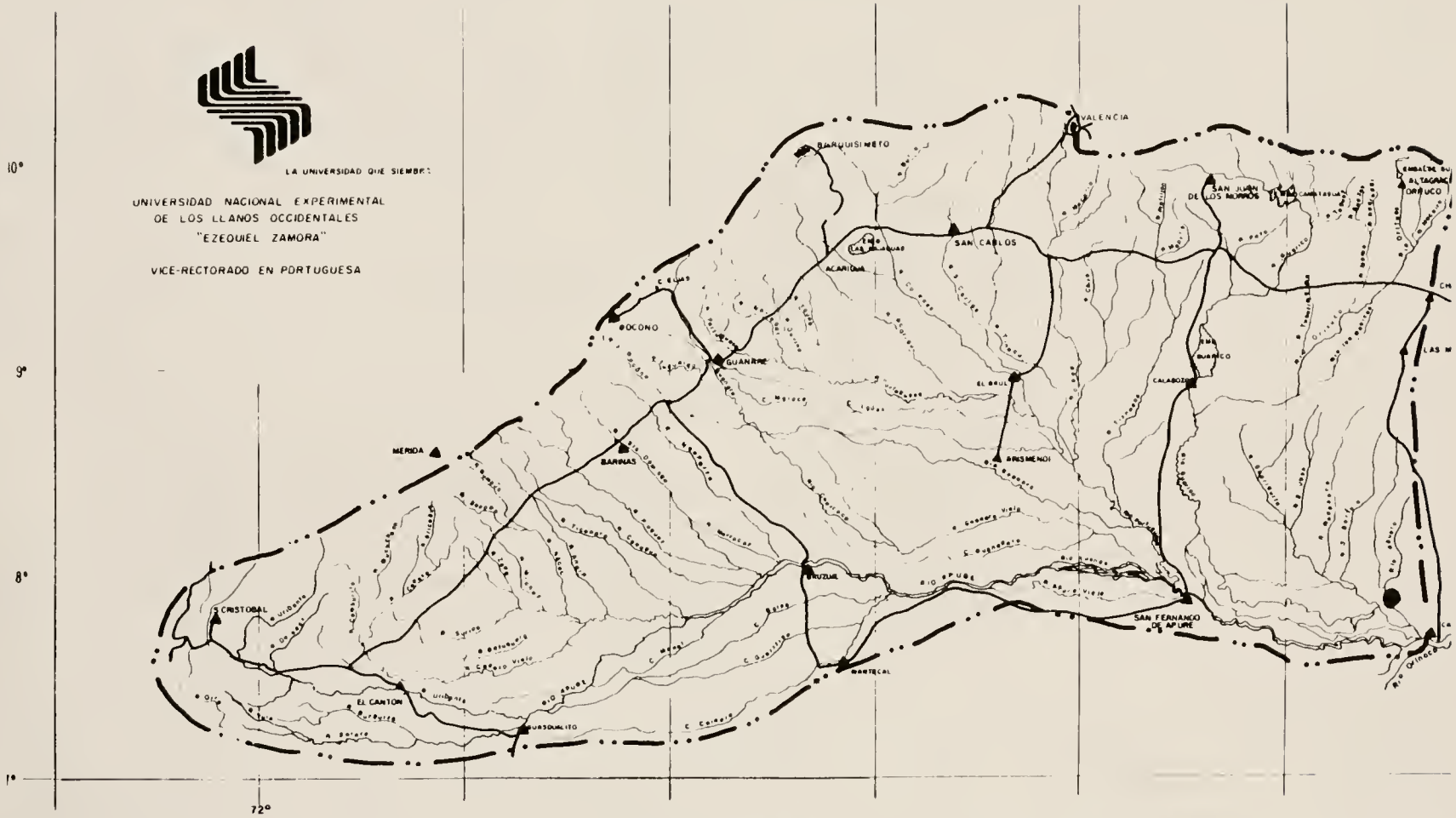
Abundance. RARE.

Number of Specimens Examined. 7 from 1 collection.

Food. BENTHIC OMNIVORE.

Importance. Ornamental.

Figure 254. Apure drainage distribution of *Elachocharax junki*.



CUENCA DEL RIO APURE

Elachocharax pulcher Myers 1927

Voladorita Enana - Dwarf South American Darter

Fig. 255. Map: fig. 256. Couplet 11b.

Specific synonymy

Elachocharax pulcher Myers 1927:114 (type locality: Venezuela: Caño de Quiribana, near Caicara,), seen; Mago L. 1970:74; Géry 1977:114, 119.

Description

Types. Holotype: IU 17676. Paratype: IU17677

Illustrations. Fig. 255; Géry 1977:118 (of holotype).

Diagnosis. see key. The presence of the adipose fin distinguishes this species from E. junki the only other species known from the Apure drainage. The high number of dorsal fin rays is sufficient to distinguish from species of Characidium.

Size. This dwarf species seldom exceeds 20 mm SL, and is usually taken much smaller.

Morphology. The lateral line is incomplete, with only 5-6 pored scales. The mouth is small, with very little gape, but the maxilla reaches a point vertical of the anterior border of the eye. Some of the anterior premaxillary teeth are bi- to tricuspid. The body is much compressed, the head is especially narrow anteriorly with a pointed snout.

Counts. DR 18; AR 8; LS 25, TS 6 from dorsal to pelvics (this count was given as 8 by Weitzman 1986, this difference might be caused by different counting methods, or the Apure specimens might represent a different taxon).

Measurements. The head length is equal to the body depth and measures 3 1/2 times in the SL.

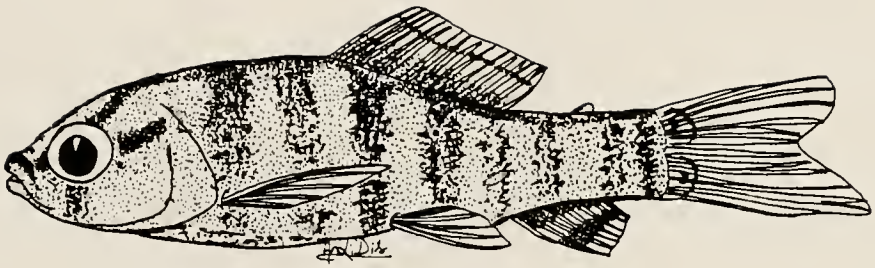


Figure 255. Elachocharax pulcher.

Pigmentation. This tiny fish is usually very darkly pigmented in life, with horizontal zig-zag lines between scale rows on sides. It body is crossed by eight diffuse but wide dark bands. The caudal fin is sometimes faintly banded. The dorsal fin has two dark stripes one very near its base, and the other located distally, but not along the outer margin of the fin. The eye is crossed by two lines, one horizontal from the chin, and the other vertical from the occiput. This color pattern undoubtedly helps this species blend in the roots and other vegetation that form its natural refuge.

Etymology. PULCHER = from the Latin for pretty.

Distribution and Natural History

Range. This species is probably present in most of the upper Río Negro in Brazil, Colombia and southern Venezuela, as well as isolated localities throughout the Orinoco Basin (in appropriate blackwater habitat). As with most characiformes, a closer examination of the isolated populations present in the Apure River drainage might reveal taxonomic differences.

Apure distribution. Map: fig. 256. It is known only from the Aguaro River system.

Habitat. It is found in blackwater streams of the low savanna. This species is said to live among fine roots of plants growing along the banks (Géry 1977), and is almost always associated with some sort of finely divided cover.

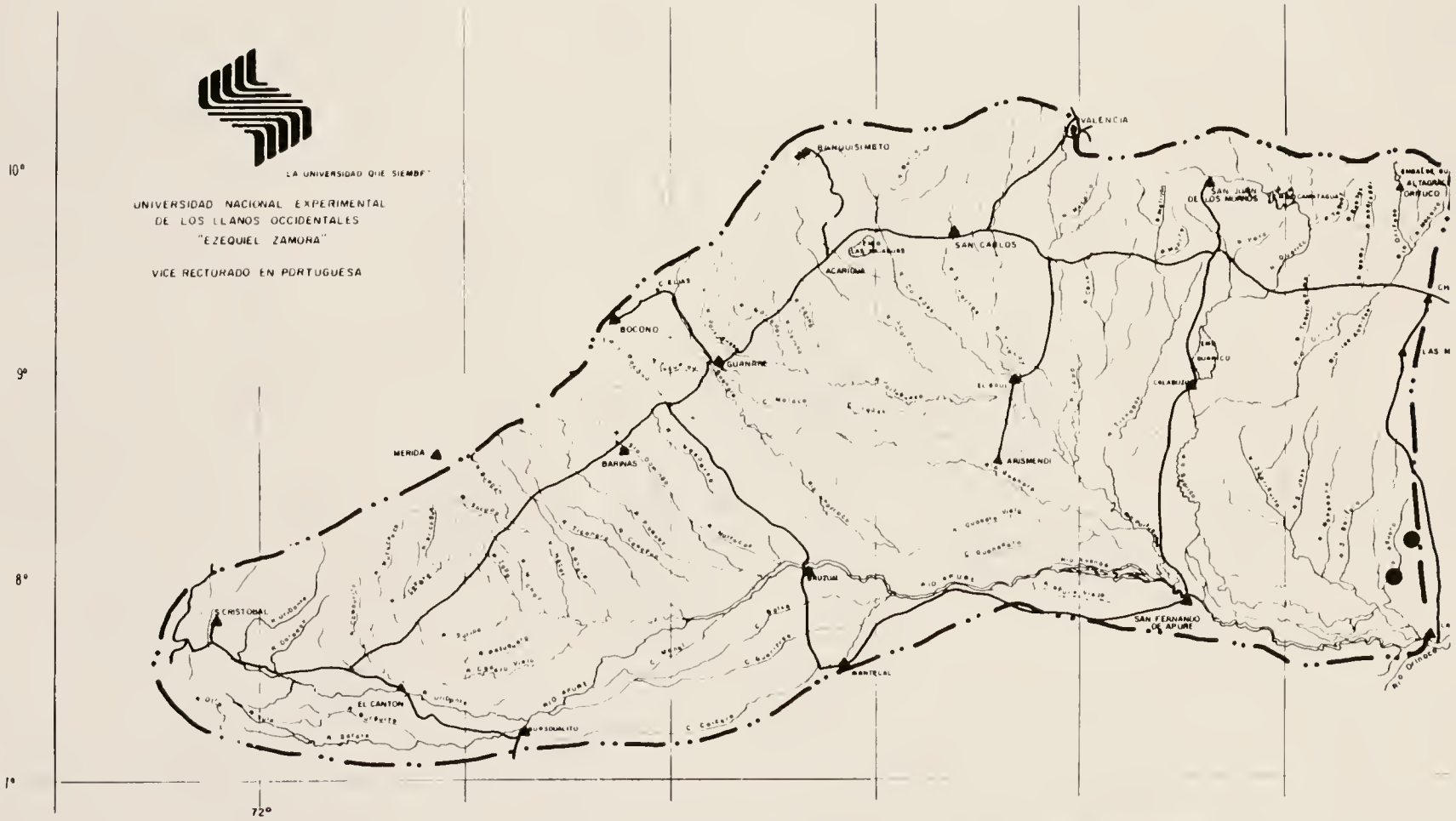
Abundance. RARE.

Number of specimens examined. 8 from 2 collections.

Food. BENTHIC OMNIVORE.

Importance. Ornamental.

Figure 256. Apure drainage distribution of *Elachocharax pulcher*.



CUENCA DEL RIO APURE

Chilodontidae

The Chilodontidae (also spelled Chilodidae by Géry [1977]) is a small family of but two genera and three or four species (Géry 1977). So far, only one of these, Chilodus punctatus, has been found in the Apure drainage. Although this group is easily recognized and distinguished, its taxonomic rank is still unclear. For example Nelson (1984) included the "Chilodontinae" as a subfamily of the Curimatidae, but Vari (1989) continues to recognize it as a distinct family. Vari (1983) considered the anatomy of the included species' epibranchial organ and pectoral girdle is sufficiently distinct to warrant familial recognition. They are most closely related to the Prochilodontidae and together with that family they form a sister group to the Anostomidae-Curimatidae pair (Vari 1983).

The chilodontids are the popular "headstanders" of the aquarium trade. They swim head-down usually in quiet waters amidst aquatic vegetation, feeding on aquatic insect larvae and other small creatures. Little is known about their natural history.

Species Accounts.

Chilodus punctatus Müller & Troschel 1844

Spotted Headstander - Conchuo

Fig. 257. Map: fig. 258.

Generic synonymy

Chilodus Müller & Troschel 1844:85 (type species: Chilodus punctatus Müller & Troschel, by monotypy; [not Chilodus Giebel 1847]); Eigenmann 1912:273; Fowler 1950:214 (synonymy).

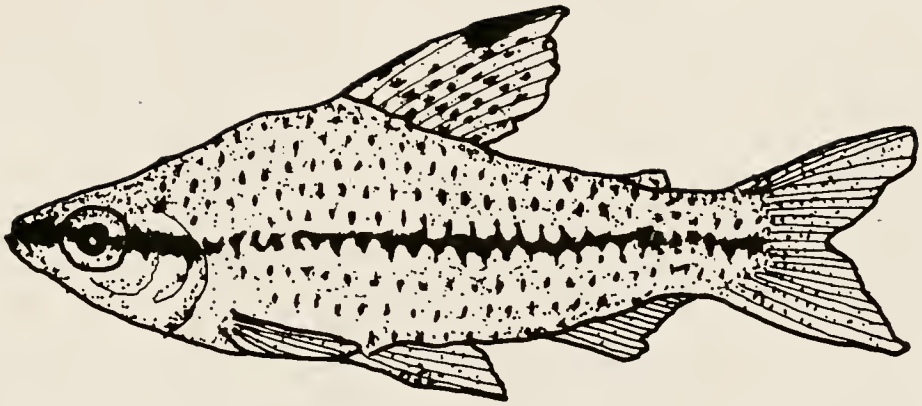


Figure 257. Chilodus punctatus.

Specific synonymy

Chilodus punctatus Müller & Troschel 1844:86 pl. 4, fig. 2 (type locality: Lake Amucu, Guyana), seen; Eigenmann 1912:273 (synonymy, description); Géry 1977:214.

Citharinus chilodus Valenciennes in Cuvier & Valenciennes 1849:103.

Caenotropus punctatus Günther 1864:297.

Types. Lectotype: ZMB 23599. Paralectotype: ZMB 24074.

Comments. Caenotropus labyrinthicus occupies neighboring drainages to the south. It's ventral mouth makes it easy to distinguish from this species.

Etymology. CHIL = lips, ODUS = teeth; PUNCTATUS = spotted.

Description

Illustrations. Eigenmann 1912:pl. 35, fig. 4; Géry 1977:212, 213; Román 1983:95.

Diagnosis. Chilodus punctatus can be recognized at once by the distinctive body form and pigmentation (fig. 257). There is a black lateral stripe from the tip of the snout, through the eye and back to the base of the tail. The tips of the first few dorsal rays are black. Each scale has a dark spot over a whitish to tan background. This species is somewhat similar to curimatids and anostomids, but is easily distinguished by the presence of a single row of feeble, truncate teeth in each jaw, and by the unique, dilated fourth gill arch.

C. punctatus can be distinguished from C. gracilis by its deeper body (GBD 2.7-3.2 vs 3.3-3.6 in C. gracilis). C. zunevi always lacks a lateral stripe, has spots around the pectoral fin, and has dorsal and ventrally placed spots of about equal intensity. In C. punctatus the lateral stripe is usually present although it is sometimes zigzag, the

spots are usually darker dorsally and are absent around the pectoral fin (Isbrücker & Nijssen 1988).

Size. It usually does not exceed 70 mm SL.

Morphology. The body is compressed and fairly deep with an elevated back. The head is conical, with a small, terminal to upturned mouth. The scales are large and entire. The lateral line is straight and complete.

Counts. DR 11; AR 12; LLS 25-27; TS 8-9.

Measurements. HL 3.7 in SL; GBD 3 in SL; EYE .75 in snout, 3 in HL, equal to interorbital (Eigenmann 1912).

Pigmentation. The base color is tan to silvery. A black lateral stripe (sometimes expressed as an interrupted series of dots and blotches) extends from the tip of the snout to the base of the caudal fin; each scale of the sides and dorsum is marked with a large black spot, and the black pigment sometimes "runs together" to form a net-like pattern. The dorsal fin has a large black blotch near its tip, and several smaller black spots proximally. The anal fin is dark, but the other fins are colorless. The belly and throat are silvery white. Géry (1977) noted that the usual spotted pigmentation pattern disappears during spawning and is replaced by a broad humeral spot.

Distribution and Natural History

Range. It is known from British Guiana, and the Orinoco and Amazon basins.

Apure distribution. Map: fig. 258. It has been found only in northern Apure state.

Habitat. It inhabits blackwater creeks, bajios and esteros.

Abundance. UNCOMMON.

Figure 258. Apure drainage distribution of *Chilodus punctatus*.

CUENCA DEL RIO APURE

Number of specimens examined. 156 from 24 collections.

Food. OMNIVORE. It probably feeds mainly on minute animal life such as microcrustaceans, aquatic insects, and other aquatic invertebrates that live on aquatic vegetation, as well as vegetable matter.

Reproduction. Strategy probably r1. Eggs are scattered in aquatic vegetation or in aquaria on artificial nylon spawning mops. The male pushes the female into the substrate then pushes its caudal peduncle under that of the female, at which time spawning occurs. Eggs are large, swelling to 2 mm, and hatch in 3-4 days (Sterba 1972).

Importance. Ornamental.

Ctenoluciidae

The pike characins are elongate, barracuda-like piscivores that prowl just beneath the water's surface seeking their prey. The family is not a large one, and Géry (1977) cited only four known species in two genera, Ctenolucius and Boulengerella. The species are readily recognized by their elongate, slender jaws and numerous, conical teeth present in both the upper and the included lower jaw, as well as on the ectopterygoid bones. The teeth point backward toward the inside of the mouth to prevent the escape of their prey. Either the tip of the snout or the tip of the lower jaw, bears a fleshy appendage that is a characteristic feature of this group. Boulengerella lucius, is the only species that has been found so far in the Apure drainage, but the other three species in the family are present in other parts of Venezuela. Ctenolucius hujeta occurs in the Maracaibo Basin, and Boulengerella lateristriga and B. maculata are present in the Amazonas Territory and Bolivar state.

Species Accounts.

Boulengerella lucius (Cuvier) 1817

Pike Characin - Agujeta

Fig. 259. Map: fig. 260.

Generic synonymy

Boulengerella Eigenmann 1903:147 (type species: Xiphostoma lateristriga Boulenger, by original designation).

Xiphostoma (not Kirby & Spence 1828 in Hemiptera) Spix in Agassiz 1829:60 (type species: Xiphostoma cuvieri Spix in Agassiz, by monotypy; Valenciennes in Cuvier & Valenciennes 1849:XIII; Jordan & Evermann 1917:132

Xiphostomus Swainson 1839:290 (type species: Xiphostomus cuvieri Spix).

Specific synonymy

Hydrocynus lucius Cuvier 1817:168 (type locality: rivers of Brazil), seen.

Hydrocyon lucius Cuvier 1819:359 (type locality: Brazil).

Xiphostoma lucius Müller & Troschel 1844:94 (locality not indicated).

Xiphostoma cuvieri Agassiz in Spix 1829:78, pl. 42 (type locality: rivers of Brazil); Pellegrin 1899:157 (Apure River, Venezuela).

Hydrocynus cuvieri Eigenmann 1910:446.

Boulengerella cuvieri Schultz 1944b:261; Fowler 1950:328 (synonymy).

Xiphostoma ocellatum Schomburgk 1841:245, pl. 23. (type locality: Essequibo; Negro and Branco rivers, Brazil).

Xiphystoma (?error) ocellatum 1895:296.

Hydrocynus ocellatus Eigenmann 1910:446 (alternative spelling).

Xiphostoma oseryi Castelnau 1855:76, pl. 40. fig. 1 (type locality: Tocantins, Brazil).

Figure 259. Boulengerella lucius.

?Xiphostoma longipinne Steindachner 1876:132, (type locality: mouth of Río Negro).

Boulengerella lucius Mago L. 1970:74.

Boulengerella (Spixostoma) lucia Géry 1977:106 (key, synonymy).

Comments. Géry (1977) called this species B. lucia, changing the ending of the specific name to make it agree with the genus. I have retained the original spelling (B. lucius). He placed it in the monotypic subgenus Spixostoma, and listed B. ocellatus, B. cuvieri and B. longipinne as probable synonyms. He regarded the other subgenus, Boulengerella, as comprising B. lateristriga and B. maculata, both of which have an incomplete lateral line, and fewer lateral-line scales (78-92).

Etymology. BOULENGERELLA = so named to honor George Albert Boulenger, a Belgian ichthyologist, who worked at the British Museum of Natural History for many years; LUCIUS = refers to the genus of the similarly shaped, and ecologically parallel species of North American pike.

Description

Illustrations. Fig. 259; Géry 1977:107.

Diagnosis. The elongate, canine-studded jaws, and fleshy appendage on the tip of the upper jaw clearly distinguish this fish from superficially similar species. It has a complete lateral line, with 97-110 scales in the lateral series above or below it. The other members of this genus, B. lateristriga and B. maculata have an incomplete lateral line, and fewer scales (78-92) in the lateral series.

Size. It is said to reach one meter, but is usually seen at less than half that size.

Morphology. The body is somewhat terete, elongate and slender. The jaws are also very elongate and narrow, and beaklike. The dorsal fin is placed far back on the body, posterior to the pelvic fins. An adipose fin is present. The tail is large, and the lower lobe is usually the larger. The lateral line is complete. The scales are finely ctenoid.

Counts. DR 10; AR 10-11; PR 25-30; VR 8; LLS 97-110.

Measurements. HL 2.8-3.4; GBD 6.5-7.5 (both in SL); eye 4.3-5 in snout, 8-8.5 in HL, 1.5-1.75 in IO (Eigenmann 1912).

Pigmentation. The body is silvery to golden in life with a few scattered spots situated dorsally in some specimens. Young specimens have a wide, black, lateral stripe that extends from the base of the caudal fin forward through the eye and out to the tip of the fleshy appendage on the snout. The caudal fin is marked with a black spot or ocellus at the base, its outermost rays are white.

Distribution and Natural History

Range. It occurs in Guyana and other northern coastal drainages of South America and in the Amazon Basin.

Apure distribution. Map: fig. 260. In the Apure drainage this species has been found only from northern Apure state between Bruzual and Mantecal, with the exception of one locality in the lower Suripá river.

Habitat. It is a lowland species often found near the quiet, vegetated edges of flowing waters of the low llanos.

Abundance. RARE.

Number of specimens examined. 11 from 10 collections.

Figure 260. Apure drainage distribution of *Boulengerella lucius*.

CUENCA DEL RIO APURE

Food. CARNIVORE. It is almost exclusively piscivorous, but probably catch other prey on occasion. It feeds near the water's surface, frequently taking refuge behind cover near the faster moving areas of streams. From there it darts out to take prey that are struggling against the current.

Importance. Ornamental. This species is also of some value as a sport fish, but because of the numerous intermuscular bones is not highly valued as a food fish.

Curimatidae

Many curimatids are analogous in general body plan, feeding strategies and ecological niches to the carps and suckers of North America. They are toothless as adults, but juveniles of some species have teeth until they reach a SL of some 20 mm, after which the teeth are reabsorbed. Almost all are benthic detritivores that feed on algae, diatoms, protozoans and bacteria from the surface layers of mud. They abound in almost all water bodies, and figure strongly in the biomass pyramid of llaneran lagoons and ponds, but also are common in slower sections of streams and rivers. A few have adopted a more pelagic, perhaps mainly planktivorous life style, as is evidenced by their keeled abdomen and modified gill rakers. Those species are usually found in or near the main channels of large rivers. All have a gut that is quite long, as in herbivores in general. The vast majority of the curimatids are plain colored, silvery fishes (though often with a black spot on the dorsal fin or caudal peduncle), with only small deviations from their generalized body plan. They are mainly diurnal, and have large eyes, often partly covered by a protective membrane.

Vari (1983, 1989) summarized and commented on the extremely varied phylogenetic schemes proposed in the past for Curimatidae, and established their relationships with the Prochilodontidae, Anostomidae and Chilodontidae. He concluded that each of these four families is monophyletic and that together they constitute a monophyletic assemblage, with two pairs of sister groups: Curimatidae with Prochilodontidae and Anostomidae with Chilodontidae.

Fernández Y. (1948) enthusiastically, and for the most part erroneously, split the family into 27 genera, and estimated some 109 species in this group. Géry (1977) estimated the family to contain 110 species and Vari (1983) estimated 120. Mago L. (1970) listed only nine species for Venezuela, but many additional species have been discovered and described since then.

Most recently, Vari (1989) listed 128 nominal taxa, but mentioned "about 100" as the number of valid species in his phylogenetic study of the family. He recognized only eight genera: Curimatopsis which includes dwarf species with an incomplete lateral line, and basal spurs on the middle caudal-fin rays of males; Potamorhina which includes large, riverine species with small scales (85-110 LLS), numerous anal-fin rays (13-19), and enlarged opercular bones; Curimata, which are large species with numerous flaps and folds on the roof of the mouth; Psectrogaster, relatively large species characterized mainly by specializations of the epibranchial bones; Steindachnerina the largest genus, and one that contains many of the smaller species formerly in Curimata; Pseudocurimata, a genus present only west of the Andes; Curimatella, comprised of small to medium sized species with scaled caudal fins; and Cyphocharax, an assemblage of "leftover species" for

which no synapomorphies were discernible, and which includes three phenetically recognizable groups: small species with a caudal peduncle spot; small species from southern South America with an incomplete lateral line; and a third group that includes the distinctively pigmented curimatids. I have followed Vari (1989) for all generic synonymies, and for the correct spellings and dates of species.

The names of the eight Apure drainage "species" employed here are still tentative. They were determined using Vari's preliminary, unpublished key to Venezuelan species (1983, photocopy) and Géry (1977). Since almost all of the species are poorly described, many are sympatric, and most are not easily recognized upon superficial visual inspection, I have opted to "lump" whenever possible. It is therefore likely that I have not recognized some closely related species.

Key to the Apure Drainage Species of Curimatidae.

1a. Caudal fin densely scaled almost to the tips of the rays... (genus *Curimatella*, 2 spp.)... ...2

1b. Caudal fin at most scaled only near base... ...3

2a. (1a) Base of caudal fin with distinct black spot, separate from lateral stripe... *Curimatella bolivarensis* (fig. 263)

2b. Base of caudal fin without a distinct black spot, separate from lateral stripe... *Curimatella immaculata* (fig. 265)

3a. (1b) Lateral-line scales 45 or more from upper junction of opercle to base of caudal fin... ...4

3b. Lateral-line scales 44 or fewer... ...7

4a. (3a) Lateral-line scales more than 90; transverse scales (from dorsal-fin to pelvic-fin insertions) more than 40... *Potamorhina altamazonica* (fig. 269)

4b. Lateral-line scales 45-60; transverse scales 15-25... ...5

5a. (4b) Mouth inferior... Steindachnerina sp. (fig. 273)

5b. Mouth terminal... ...6

6a. (5b) Interorbital width 53-58% of head length; gill rakers long and slender, about 40 on first arch; AR iii10-iii12; ventrum, pectoral, pelvic, and anal fins usually red in life...

Curimata cerasina (fig. 261)

6b. Interorbital width less than 52% of head length; gill rakers replaced by membranous flap (actually reduced to tiny protuberances along base of flap); anal rays iii8-iii9; ventrum and fins not red... Psectrogaster ciliatus (fig. 271)

7a. (3b) Dorsal fin with black dot, often faint or faded; lateral scales not usually outlined in black...

Steindachnerina argentea (fig. 275)

7b. Dorsal fin plain, without black dot; lateral scales often outlined with black... Cyphocharax spilurus (fig. 267)

Species Accounts.

Curimata cerasina Vari 1983

Cherry Curimatid - Coporo Pechirojo

Fig. 261. Map: fig. 262. Couplet 6a.

Generic synonymy

Curimata Bosc 1817 (type species: Salmo edentulosus Bloch 1794, by monotypy).

Curimatus Valenciennes in Cuvier & Valenciennes 1849:7 (alternative spelling).

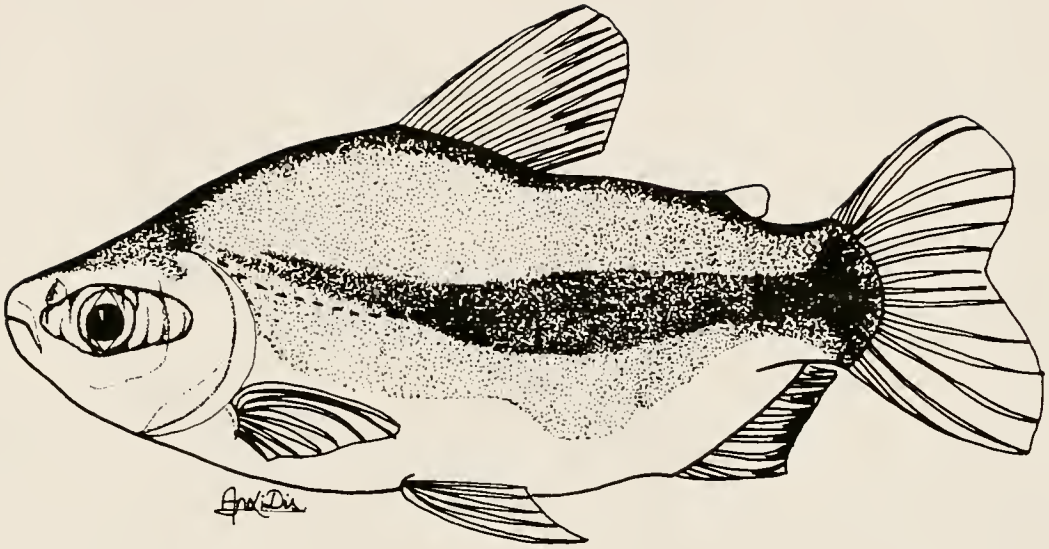


Figure 261. Curimata cerasina.

Semitapicis Eigenmann & Eigenmann 1889b (type species: Charax planirostris Gray, 1854, by original designation).

Peltapleura Fowler 1906:300 (type species: Salmo cyprinoides Linnaeus, by original designation).

Acuticurimata Fowler 1941 (type species: Curimatus macrops Eigenmann & Eigenmann 1889b, by original designation)

Allenina Fernández Y. 1948 (type species: Curimata murieli Allen 1942 in Eigenmann & Allen 1942, by original designation).

Lambepiedra Fernández Y. 1948 (type species: Lambepiedra alleni Fernández Y. 1948, by original designation).

Bitricarinata Fernández Y. 1948 (type species: Curimatus schomburgkii Günther 1864, by original designation).

Bondichthys Whitley 1953 (type species: Curimatus mivartii Steindachner 1878, by original designation).

Stupens Whitley 1954 (type species: Curimatus simulatus Eigenmann & Eigenmann 1889b, by original designation).

Semitapiscis Braga & Azpelicueta 1983 (unjustified emendation of Semitapicis).

Specific synonymy

Curimata cerasina Vari 1983:27 (type locality: Venez., Apure state, flooded area along road from San Fernando de Apure to Arichuna, 15 km SW of San Fernando de Apure), seen.

Curimata schomburgkii Mago L. 1967:254; Román 1985:135 (photo, description).

Curimata ciprinoides Taphorn & Lilyestrom 1984:55 (biology).

Types. Holotype: MBUCV V-140.25. Paratypes: at MBUCV, USNM, CAS, FMNH, BMNH, ANSP, AMNH, MCZ.

Comments. The name Curimata instead of Curimatus is used in compliance with Opinion 722 (1966) of the International Commission of Zoological Nomenclature.

Etymology. CURIMATA = a native (Brazilian) name for these fishes; CERASINA = cherry like, referring to the red ventrum.

Description

Illustrations. Fig. 261. Vari 1983:40; Román 1985:135 (as C. schomburgkii).

Diagnosis. This is the only large red-bellied curimatid in the Apure drainage. It is further distinguished by the lack of scales on the caudal fin, except at the base; by a very wide head (the interorbital width is 53-58% of the head length); the presence of about 40 elongate slender gill rakers on the first gill arch; and 42-50 lateral-line scales.

Size. This is a large curimatid that grows to about 170 mm SL.

Morphology. The scales are large and easily visible without magnification. The chest is flattened and has distinct lateral longitudinal keels from level of a vertical through the pectoral-fin insertion to the insertion of the pelvic fin. There is a well developed median keel posterior to the pelvic-fin insertion (Vari 1983). The adipose fin is large. The mouth is terminal, with large lips.

Counts. DR ii9-ii10; AR ii10-iii12; PR i13-i15; VR i8-i9; LLS 42-50; TS about 22; GR more than 40 long rakers, 31-33 vertebrae.

Pigmentation. The body is silvery on the dorsum and sides, but (in life) the chest, pectoral, pelvic and anal fins are cherry red, particularly during the breeding season. The anal and caudal fins are sometimes edged in black.

Figure 262. Apure drainage distribution of *Curimata cerasina*.

CUENCA DEL RIO APURE

Distribution and Natural History

Range: It is known from the Orinoco Basin.

Apure distribution: Map: fig. 262. Curiously, it is absent from the westernmost portion of the drainage. It occurs in the piedmont and both high and low llanos.

Habitat. It lives in both lotic and lentic whitewater habitats, and is usually taken over muddy substrates.

Abundance. COMMON.

Number of specimens examined. 253 from 69 collections.

Food. DETRITIVORE. It feeds on algae, diatoms, bacteria and protozoans from mud and detritus.

Reproduction. Probably Strategy r2. Ripe females were found from late March to April, and juveniles (17-60 mm SL) were taken from floating and emergent vegetation from July and August (Vari 1983).

Migration. It is large enough to accompany the coporo *Prochilodus mariae* on its annual migrations, but this has not been documented.

Importance. It has some potential as an ornamental, but grow too large for aquaria.

Curimatella bolivarensis (Steindachner) 1910

Curimata - Coporito

Fig. 263. Map: fig. 264. Couplet 2a.

Generic synonymy

Curimatella Eigenmann & Eigenmann 1889b:415 (type species: *Curimatus lepidurus* Eigenmann & Eigenmann 1889b, by subsequent designation of Eigenmann 1910:420); Fowler 1950:295 (synonymy).

Apolinarella Fernández Y. 1948 (type species: *Curimatus meyeri* Steindachner 1882, by original designation).

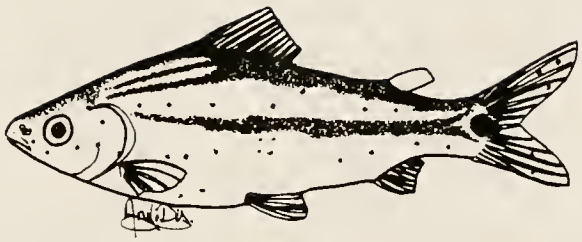


Figure 263. Curimatella bolivarensis.

Walbaunina Fernández Y. 1948 (type species: Curimatus dorsalis Eigenmann & Eigenmann 1889b, by original designation).

Lepipinna Fernández Y. 1948 (type species: Anodus alburnus Müller & Troschel 1845, by original designation).

Specific synonymy

Curimatella bolivarensis Steindachner 1910:265 (type locality: Orinoco River at Ciudad Bolivar), seen; Schultz 1944b:249 (key).

Curimatella bolivarense Mago L. 1970:75.

Etymology. CURIMATELLA = a diminutive of Curimata; BOLIVARENSIS = from Ciudad Bolivar, Venezuela.

Description

Illustrations. Fig. 263; Román 1985:134.

Diagnosis. This curimatid is distinguished by having the caudal fin almost entirely scaled, and by the presence of a large black blotch on the caudal peduncle that is separate from the lateral stripe (if the latter is present).

Size. It seldom exceeds 80 mm SL.

Morphology. See previous account for C. argentea.

Counts. DR ii9; AR iii7; PR i12; VR i8; LLS 32-36; TS 13; GR short, more than 40 in total number.

Pigmentation. The body is silvery with a rounded black spot at the base of the caudal fin. The fins are colorless.

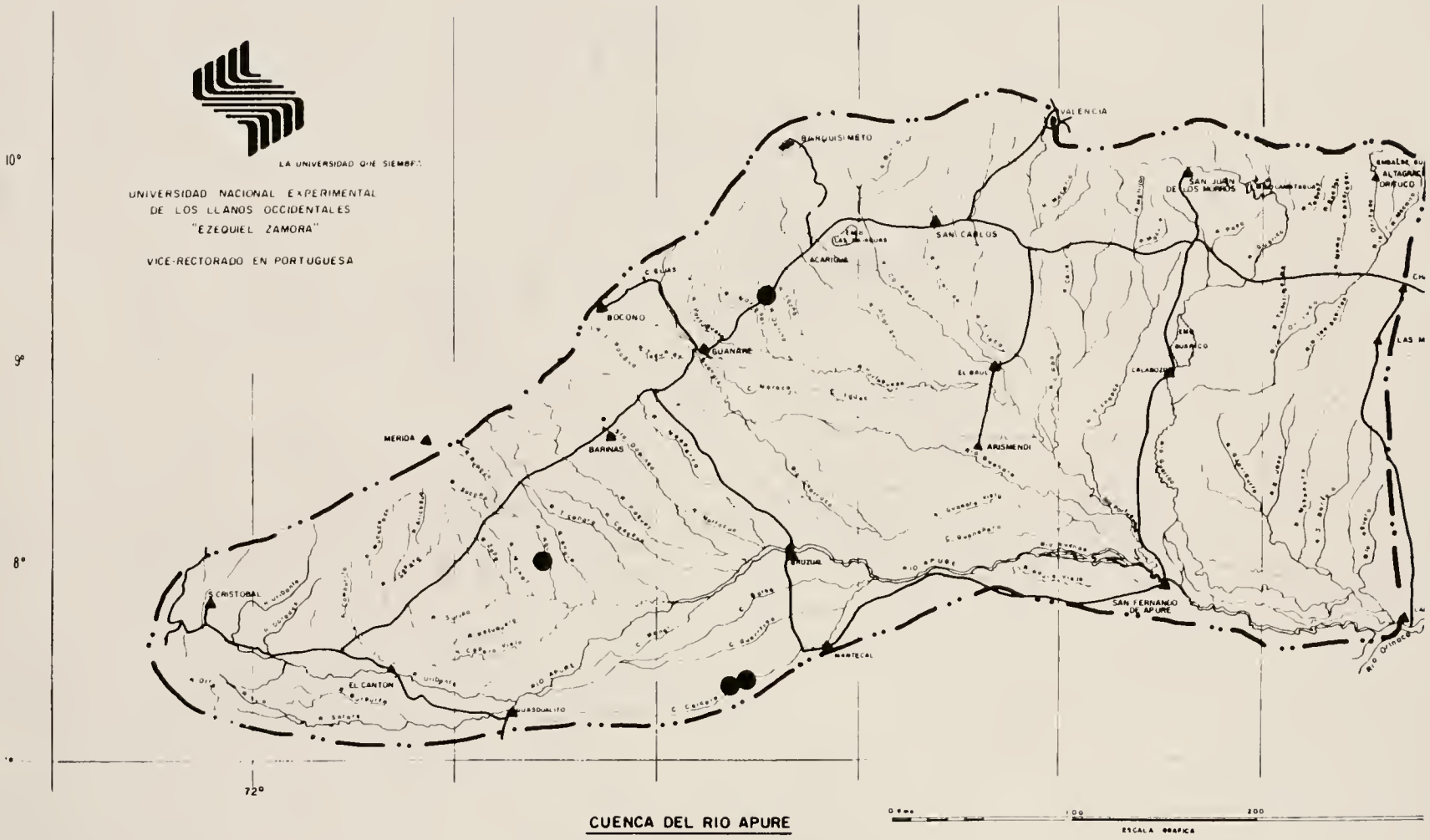
Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 264. This species is very scarce.

Habitat. The four points of collection for this species indicate a wide range of habitat. One is in the piedmont over a rocky substrate

Figure 264. Apure drainage distribution of *Curimatella bolivarensis*.


LA UNIVERSIDAD QUE SIEMBRA
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
GUANARE
MERIDA
BARINAS
EL BAUL
ARISMENDI
SAN JUAN DE LOS MORROS
LALABOZA
ENCUARICO
ALTAGRACIA ORITUCO
SAN FERNANDO DE APURE
MANTECAL
GUASDUALITO
EL CANTON
S. CRISTOBAL
RIO APURE
Rio Orinoco
CUENCA DEL RIO APURE
ESCALA GRAFICA

one in the high llanos, and two in blackwater low llaneran streams.

Abundance. RARE.

Number of specimens examined. 32 from 7 collections.

Food. DETRITIVORE.

Reproduction. Strategy probably r2.

Importance. It is marginally valuable as an ornamental.

Curimatella immaculata (Fernández Yépez) 1948

Curimatella - Coporito

Fig. 265. Map: fig. 266. Couplet 2b.

Specific synonymy

Lepipinna immaculata Fernández Y. 1948:27 (type locality: Obidos, Brazil).

Curimatella immaculata Géry 1977:238 (lists as synonym of Curimatella alburna); Vari 1989 (assigns to Curimatella).

Comments. This species was posthumously attributed to Eigenmann by Fernández Yépez (1948), who found a specimen identified and named as a new species by Eigenmann, Indiana U.M. 4316 (now presumably at CAS), that had never been formally described. Since Eigenmann never published the name, authorship is attributed to Fernández Y. In the original description Fernández Y. (1948) first spelled the specific name as immaculata then as inmaculata in the figure legend and in later text, but again as Lepipinna immaculata and Curimatus immaculatus in the index. Since Fernández Yépez used the spelling "immaculatus" first in his publication, and both Géry (1977) and Vari (1989) also used that spelling, I have done the same here.

Etymology. IMMACULATA = without spots.

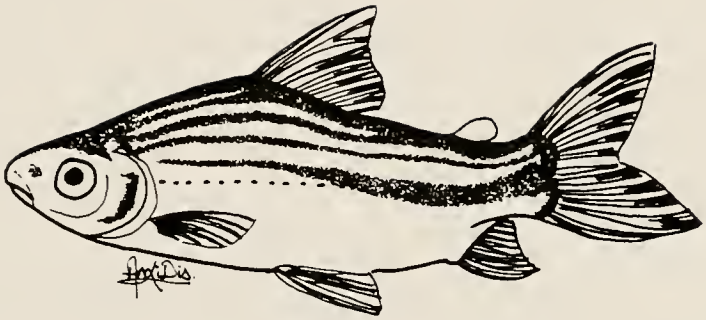
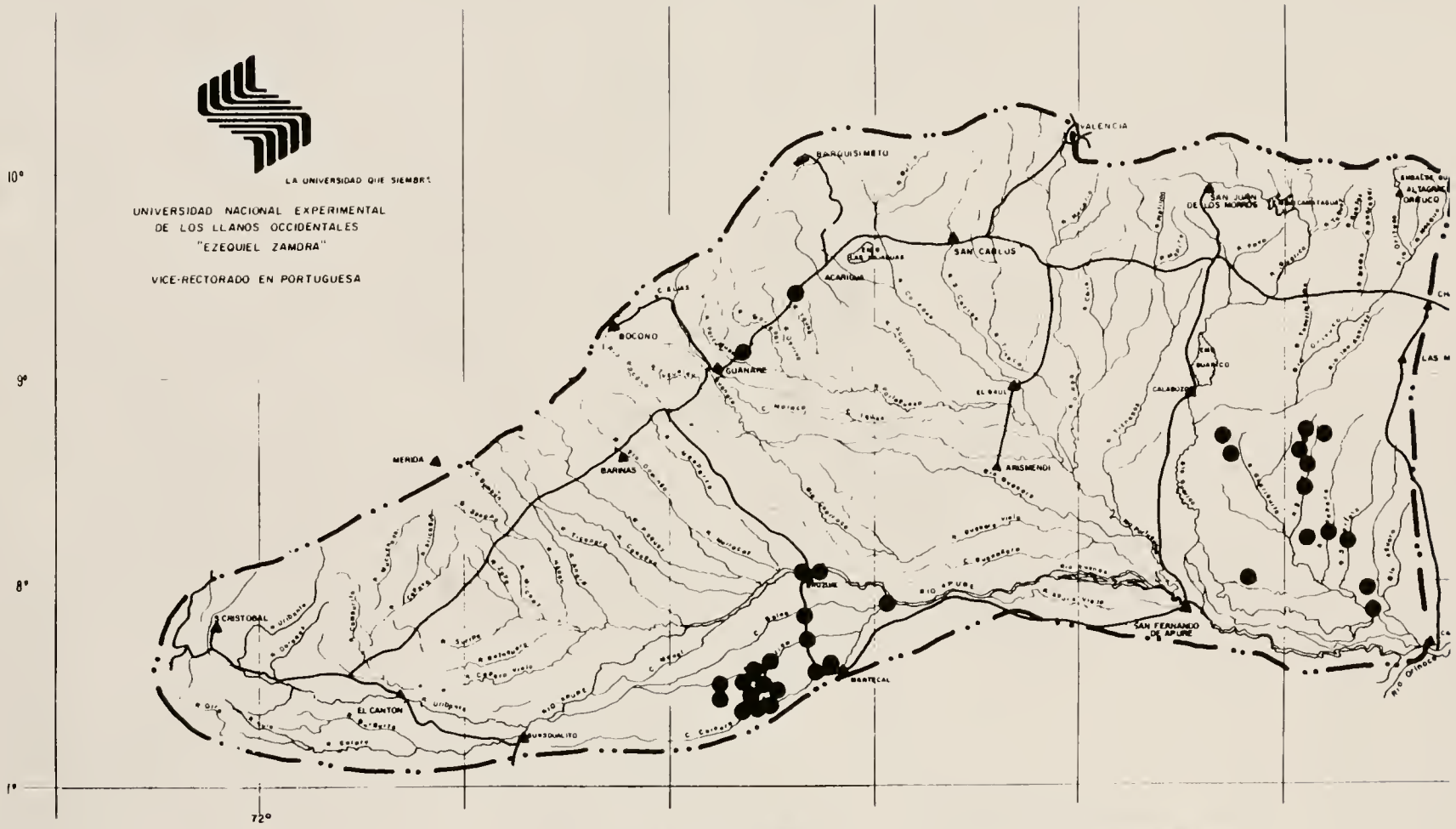


Figure 265. Curimatella immaculata.

Figure 266. Apure drainage distribution of *Curimatella immaculata*.



CUENCA DEL RIO APURE

Description

Illustrations. Fig. 265; Fernández Y. 1948:27.

Diagnosis. Species of the genus *Curimatella* differ from *Curimata* in having an almost completely scaled caudal fin. As its name suggests, *Curimata immaculata* completely lacks black markings.

Size. It grows to about 80 mm SL.

Counts. DR ii9; AR iii8; PR i12; VR i8; LLS about 35; TS 12; GR more than 40 short rakers (total).

Pigmentation. There is no dark black pigmentation of any kind in this species, though a brownish lateral stripe is often present in preserved material.

Distribution and Natural History

Range. It is known from the Orinoco and Amazon basins.

Apure distribution. Map: fig. 266. It is most common in the low llaneran areas of northern Apure state and the Aguaro River system.

Habitat. It has been found mostly in blackwater streams, except for two isolated sites in the Andean piedmont.

Abundance. COMMON.

Number of specimens examined. 2809 from 103 collections.

Food. DETRITIVORE.

Reproduction. Strategy probably r2.

Importance. *Curimatella immaculata* is a peaceful fish in aquaria and so is marginally valuable as an ornamental.

Cyphocharax spilurus (Günther) 1864

Curimata - Coporito

Fig. 267. Map: fig. 268. Couplet 7b.

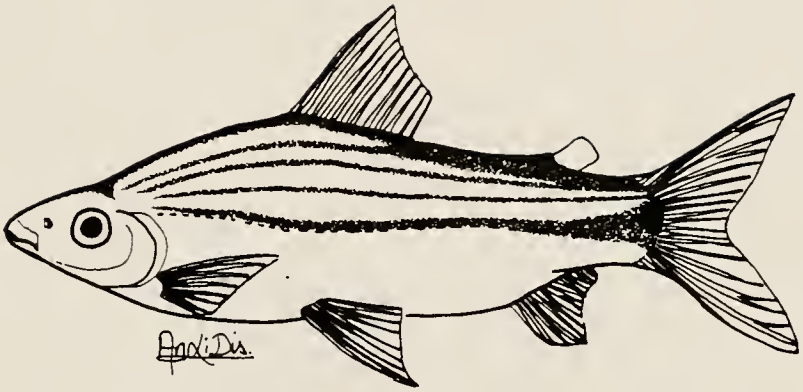


Figure 267. Cyphocharax spilurus.

Generic synonymy

Cyphocharax Fowler 1906 (type species: Curimatus spilurus Günther 1864).

Xyrocharax Fowler 1913b (type species: Curimata stigmaturus Fowler 1913b, by original designation).

Hemicurimata Myers 1929 (type species: Curimata esperanzae Myers 1929, by original designation).

Curimatoides Fowler 1940 (type species: Curimatoides ucayalensis Fowler 1940, by original designation).

Cruxentina Fernández Y. 1948 (type species: Curimata hypostoma hastata Allen 1942 in Eigenmann & Allen 1942, by original designation).

Specific synonymy

Curimatus spilurus Günther 1864:288 (type locality: Essequibo, British Guiana), seen; Steindachner 1879:5 (Ciudad Bolivar, Venez.); Eigenmann 1922:263, pl. 34, fig. 1 (British Guiana).

Curimata spilura Schultz 1944b:249 (key); Géry 1977:235.

Etymology. CYPHO = from the Latin "cifra" for zero, probably in reference to the lack of teeth; CHARAX = as in the genus Charax one of the first characid genera to be described, and a common root name formation; SPIL = spot, URA = tail, referring to the black spot on the caudal peduncle.

Description

Illustrations. Fig. 267; Géry 1977:226, 233; Román 1985:138.

Diagnosis. This fish is distinguished from the very similar C. argentea by the lack of a spot in the dorsal fin. It has about 33-36 lateral-line scales. The caudal fin is scaled only near its base.

Size. This is a small to medium curimatid that seldom exceeds 100 mm SL.

Morphology. See account for S. argentea. Günther remarked on the different morphologies observed in the two specimens he used to describe this species. He stated "The two specimens on which I have founded this species differ most remarkably in the form of the body, although they agree in every other point, so that there can be no doubt that they are of one species. One has the body elevated like a C. cyprinoides, its depth being two-fifths of the total length (without caudal); the other has the body oblong, its depth being contained thrice and a third in the total. Both are of the same length." I have observed similar differences in the Apure specimens, and suspect that sexual dimorphism might explain the above phenomenon.

Counts. DR ii9-ii10; AR iii8; PR i12; VR i8; LLS 33-36; TS 12; GR short about 35 in number (total).

Pigmentation. The body is silvery with the scales sometimes outlined with black, a faint lateral band and a dark black dot on the caudal peduncle. The fins are colorless.

Distribution and Natural History

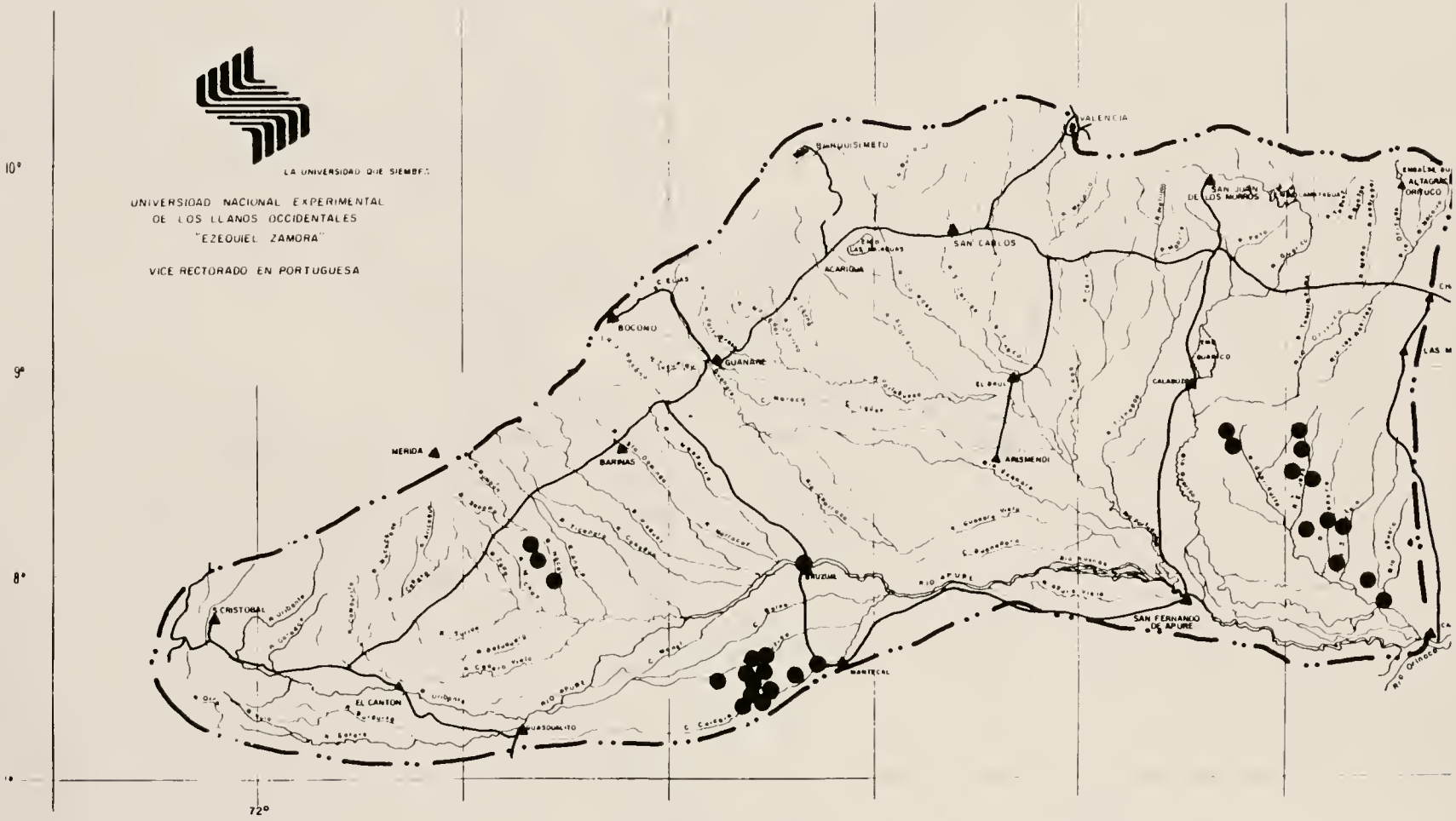
Range. It has been reported from most of South America, in the Guianas, the Orinoco, and the Amazon basins. However, this "species" is probably a group of sister species, and so each would have a more limited distribution.

Apure distribution. Map: fig. 268. This species is most abundant in Barinas state, in the Suripá River system; in northern Apure state near Mantecal, and from the Aguaro River system in the state of Guárico.

Habitat. It is usually found in streams or ponds with clear or black waters, often amidst aquatic vegetation.

Abundance. COMMON.

Figure 268. Apure drainage distribution of *Cyphocharax spilurus*.



CUENCA DEL RIO APURE

Number of specimens examined. 2291 from 68 collections.

Food. DETRITIVORE.

Reproduction. Strategy probably r2.

Importance. The are marginally valuable as an ornamental.

Potamorhina altamazonica (Cope) 1878

Manamana

Fig. 269. Map: fig. 270. Couplet 4a.

Generic synonymy

Potamorhina Cope 1878:685 (type species: Curimatus (Anodus) pristigaster Steindachner 1876, by original designation); Fowler 1950:298 (synonymy).

Gasterotomus Eigenmann 1910 (type species: Anodus latior Spix in Agassiz 1829, by original designation).

Gasterostomus Fernández Y. 1948 (incorrect spelling).

Suprasinelepichthys Fernández Y. 1948 (type species: Curimatus laticeps Valenciennes 1849, by original designation).

Potamorrhina Braga & Azpelicueta 1983 (unjustified modification of Potamorhina).

Specific synonymy

Curimatus altamazonica Cope 1878:684 (type locality: Peruvian Amazon).

Anodus laticeps Eigenmann & Allen 1942:300.

Etymology. POTAMO = river, RHINA = nose, (significance obscure); ALT = upper, AMAZONICA = from the Amazon.

Description

Illustrations. Fig. 269.

Diagnosis. This is the only curimatid in the Apure drainage with such small scales, more than 90 in the lateral-line series. The scales

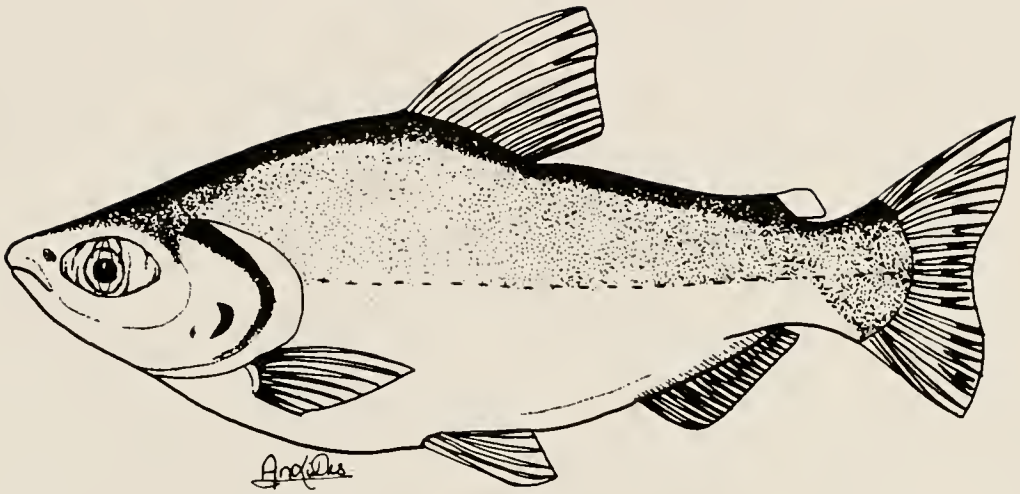
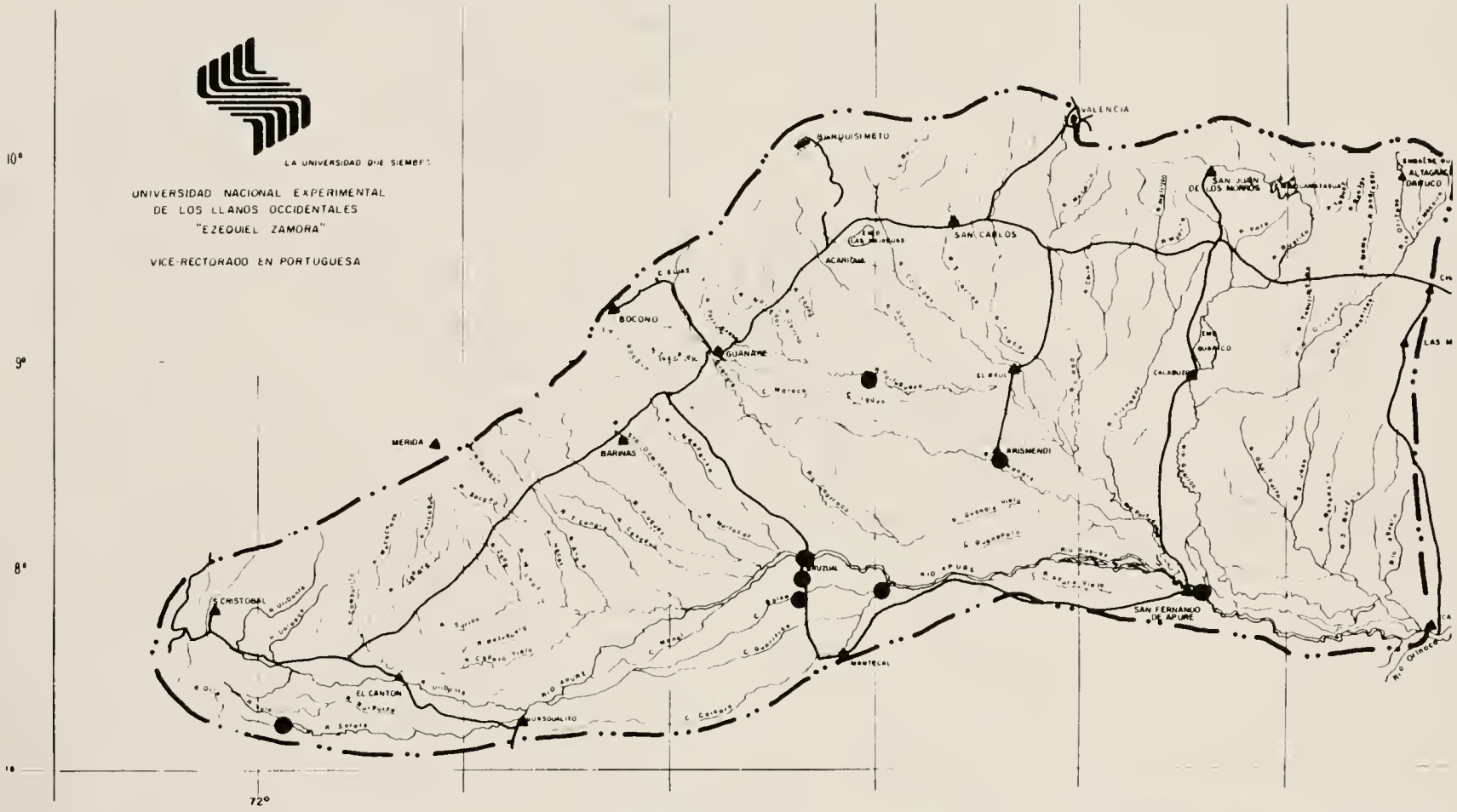


Figure 269. Potamorhina altamazonica.

Figure 270. Apure drainage distribution of *Potamorhina altamazonica*.



CUENCA DEL RIO APURE

are so small that they are difficult to see without magnification. The body and fins completely lack black markings.

Size. This is a large curimatid that reaches over 150 mm SL.

Morphology. The head and body are somewhat elongate, and the fins somewhat long for a curimatid.

Counts. DR ii10; AR iii12; PR i16; VR i8; LLS about 120; TS about 47; the gillrakers are replaced by a membranous flap.

Pigmentation. This fish is plain silvery with colorless fins.

Distribution and Natural History

Range. It is known from the Orinoco and Amazon basins.

Apure distribution. Map: fig. 270. It is known only from the low llanos.

Habitat. This species has been collected mostly from the main channels of larger rivers in the low llanos, over muddy substrates. It is more riverine than many Apure drainage curimatids.

Abundance. RARE.

Number of specimens examined. 16 from 4 collections.

Food. DETRITIVORE.

Reproduction. Strategy probably r2. It is probably an egg scatterer with no parental care, with an annual spawning bout at the beginning of the rainy season.

Psectrogaster ciliatus (Müller & Troschel) 1845

Manamana

Fig. 271. Map: fig. 272. Couplet 6b.

Generic synonymy

Psectrogaster Eigenmann & Eigenmann 1889a:412 (type species: *Psectrogaster rhomboides* Eigenmann & Eigenmann, by original designation).

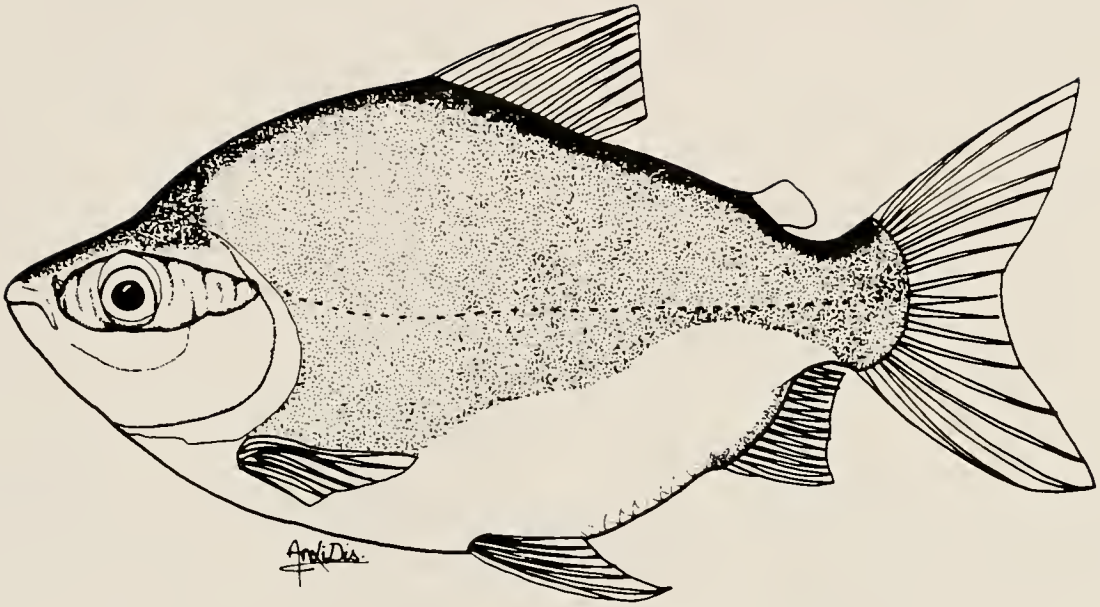


Figure 271. Psectrogaster ciliata.

Pseudopsectrogaster Fernández Y. 1948 (type species: Psectrogaster curviventris Eigenmann & Kennedy 1903, by original designation).

Hamatichthys Fernández Y. 1948 (type species: Anodus ciliatus Müller & Troschel 1845, by original designation).

Semelcarinata Fernández Y. 1948 (type species: Curimatus rutiloides Kner 1859, by original designation).

Specific synonymy

Anodus ciliatus Müller & Troschel 1845:26, pl. 4, fig.4. (type locality: Essequibo River, British Guiana).

Curimatus ciliatus Castelnau 1855:58; Eigenmann 1912:268 (synonymy).

Psectrogaster ciliata Eigenmann & Eigenmann 1889:413 (alternative spelling).

Plectrogaster (error) ciliata Berg 1897:278.

Psectrogaster ciliatus Eigenmann 1910:420.

Curimata ciliatus Fowler 1906:305.

Curimata ciliata Fowler 1950:279; Géry 1977:228.

Curimatus essequibensis Günther 1864:294 (Essequibo); Eigenmann & Eigenmann 1889:23. Eigenmann & Eigenmann 1891:48.

Curimatus rutiloides Cope (not of Kner) 1872:258 (Ambyiacu).

Curimatus cyprinoides (not of Linnaeus) Cope 1872:291.

Curimata abramoides Taphorn & Lilyestrom 1984:55 (biology).

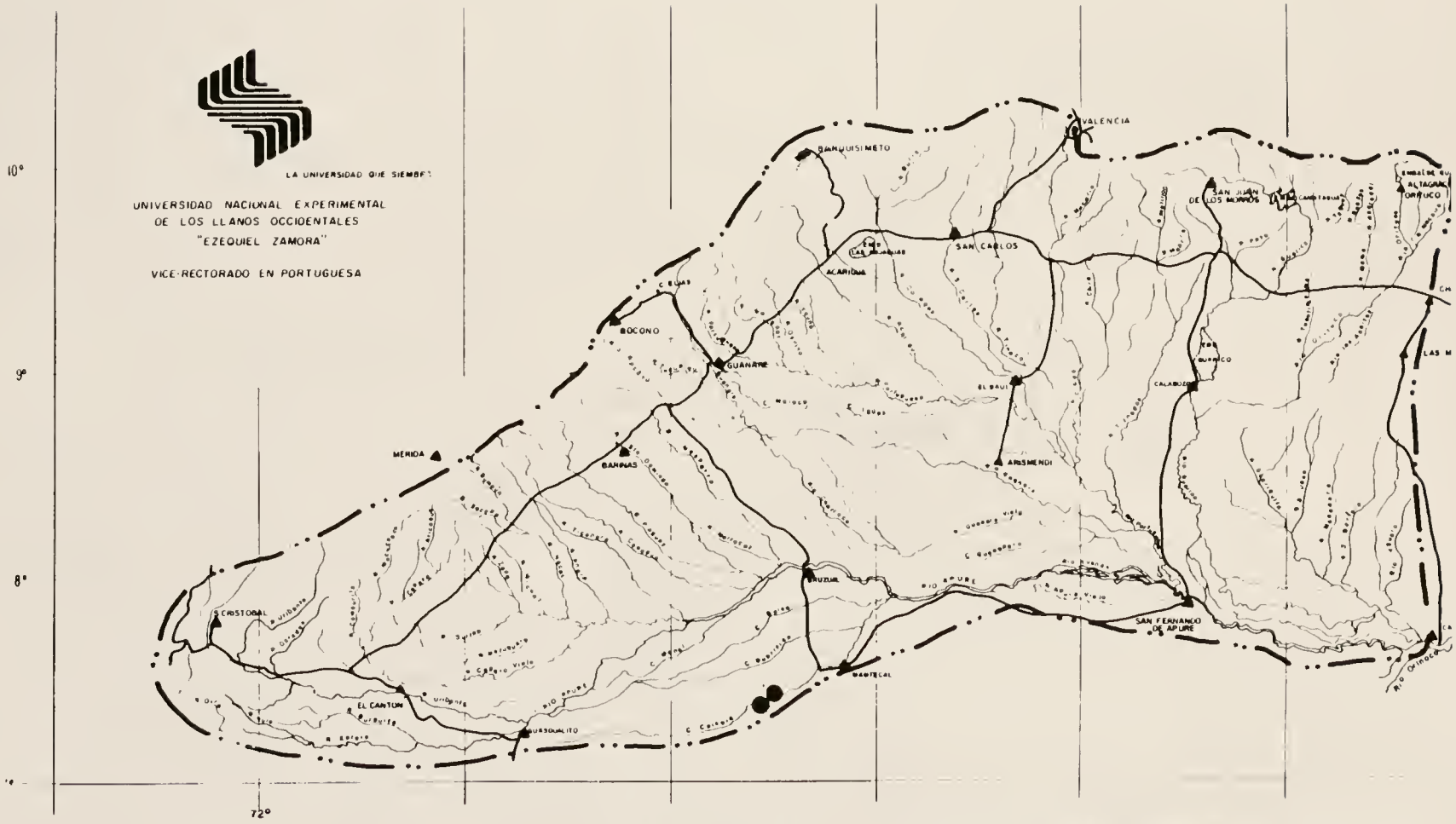
Etymology. PSECTRO = sawlike, GASTER = belly; CILIATUS = refers to the ctenoid scales of this species.

Description

Illustrations. Fig. 271; Géry 1977:228 (as Curimata ciliata).

Size. This is one of the larger curimatids in the Apure drainage. It reaches over 170 mm SL.

Figure 272. Apure drainage distribution of *Psectrogaster ciliatus*.



CUENCA DEL RIO APURE

Morphology. This is a robust and very deep-bodied fish. The strongly ctenoid scales are small in the area in front of the dorsal fin on the upper sides but are progressively larger from there down to the area in front of the pelvic fins.

Counts. DR ii9- ii10; AR iii8; PR i14; VR i8; LLS about 50-61; TS 22; the gillrakers are replaced by membranous flap.

Pigmentation. This fish is plain silvery, with colorless fins.

Distribution and Natural History

Range. It is known from the Orinoco and Amazon basins.

Apure distribution. Map: fig. 272. It is so far known only from near the Apure modules, west of Mantecal in northern Apure state.

Habitat. It is known only from a blackwater stream in the low llanos.

Abundance. UNCOMMON.

Number of specimens examined. 20 from 12 collections.

Food. DETRITIVORE.

Reproduction. Probably strategy r2. It is probably an egg scatterer with no parental care, high fecundity and annual spawning at the beginning of the rainy season.

Steindachnerina sp.

Yellowtail Curimata - Coporito

Fig. 273. Map: fig. 274. Couplet 5a.

Generic synonymy

Steindachnerina Fowler 1906 (type species: *Curimatus trachystetus* Cope 1878, by original designation).

Rivasella Fernández Y. 1948 (type species: *Curimatus melaniris* Fowler 1940, by original designation).

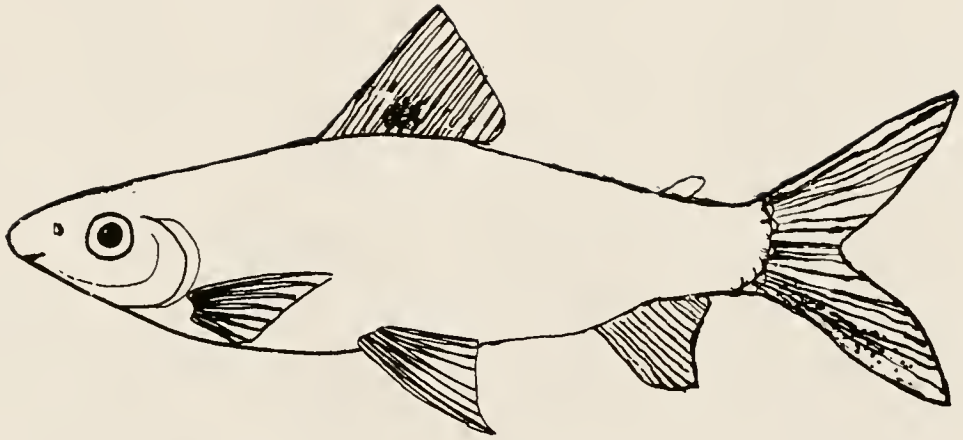


Figure 273. Steindachnerina sp.

Curimatorbis Fernández Y. 1948 (type species: Curimatus atratoensis Eigenmann 1912b, by original designation).

Comments. I had placed this species in the genus Cruxentina Fernández Y. (1948) but that genus is now considered (Vari 1989) a junior synonym of Cyphocharax. But, because I have not examined its osteology, and because it lacks the caudal spot and corporal pigmentation attributed to members of Cyphocharax, I assign it here tentatively to Steindachnerina. It has several other unusual features, such as a slender, elongate body, an elevated lateral-line scale count, and a pigmented (yellow and black) caudal fin. The other possibility is that it is a species of Cyphocharax. Both genera were delimited by Vari (1989). This form probably represents a new species.

Etymology. STEINDACHNERINA = after F. Steindachner, an Austrian ichthyologist who pioneered research in South American fishes.

Description

Illustrations. Fig. 273.

Diagnosis. This is the only Apure drainage curimatid with a strictly inferior mouth. It is further distinguished by having about 50 scales in the lateral-line, and the caudal-fin scaled only near its base.

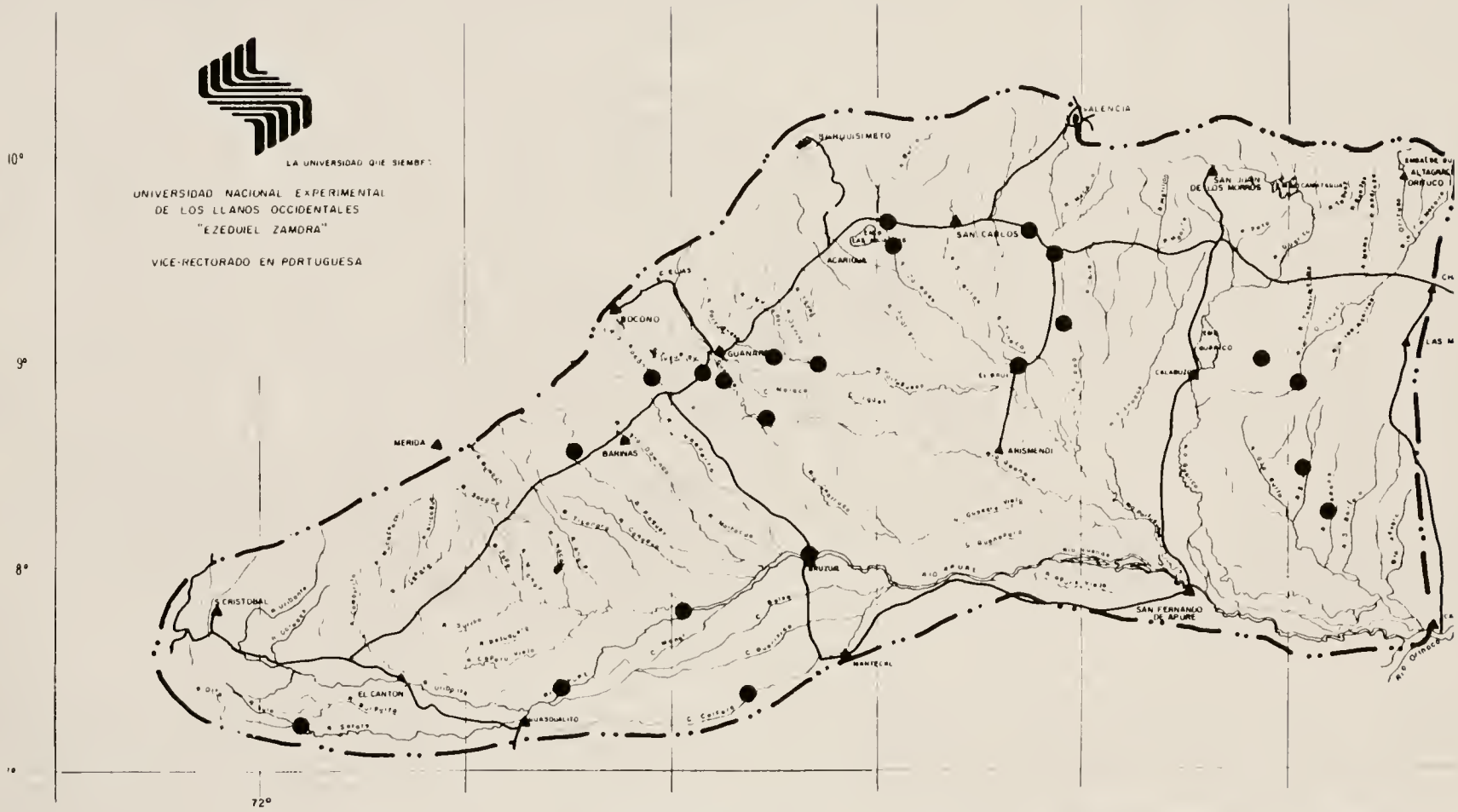
Size. It usually does not exceed 100 mm SL.

Morphology. The body is somewhat more elongated than in other Apure curimatids. The tail is large, and deeply forked.

Counts. DR ii9; AR iii7; PR i14; VR i8; LLS 50; TS 16; GR about 37.

Pigmentation. The body is silvery, and the dorsal fin usually has a black dot. The caudal fin (in life) is often marked with parallel

Figure 274. Apure drainage distribution of Steindachnerina sp.



CUENCA DEL RIO APURE

gray (to black) and yellow streaks along the upper and lowermost rays.

Distribution and Natural History

Range. It is probably restricted to the Orinoco Basin.

Apure distribution. Map: fig. 274. This species is most common in the higher portions of the llanos and in the piedmont.

Habitat. It occurs in lotic habitats from piedmont to low llanos, in both white and black waters, and from large rivers as well as small streams.

Abundance. COMMON, but much less so than most other curimatids.

Number of specimens examined. 182 from 27 collections.

Food. DETRITIVORE.

Reproduction. Strategy probably r2.

Importance. It is potentially valuable as an ornamental due to its peaceful nature, colorful tail, and a disposition to clean detritus from the bottom of its tank.

Steindachnerina argentea (Gill) 1858

Curimata - Coporito

Fig. 275. Map: fig. 276. Couplet 7a.

Specific synonymy

Curimatus argenteus Gill 1858:62 (type locality: Trinidad), seen; Eigenmann 1920:9 (El Concejo, Río Tiquirito, Maracay y Río Bué, Venez.); Pearse 1920:21 (Mouth of Río Bué, Lago Valencia in Maracay, Venez.); Eigenmann 1922:230 (Villavicencio, Colombia; Río Tiquirito, near Caracas, Río Bue near Maracay, Venez.).

Curimata argentea Schultz 1944b:249 (key, description); Fowler 1931:407 (Pitch Lake at Guanoco, Venez.); Román 1985:138 (description, photo); Géry 1977:235 (key).

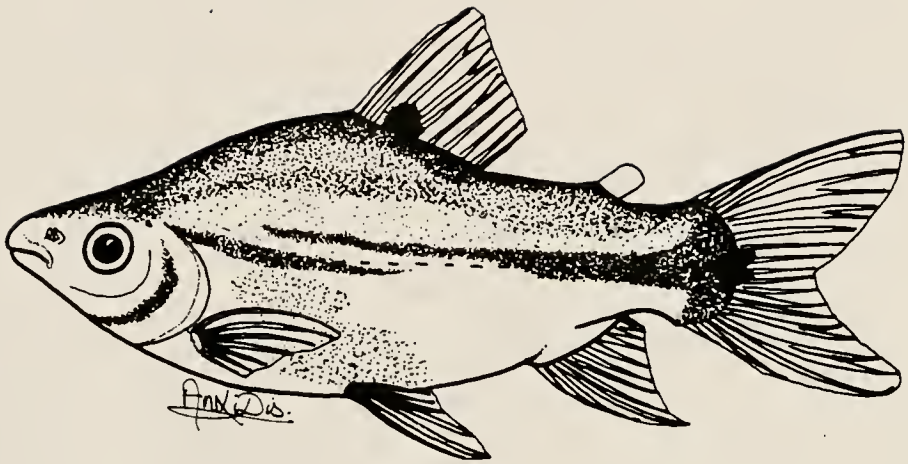


Figure 275. Steindachnerina argentea.

Curimatus metae Eigenmann 1922:230 pl.42, fig. 1 (type locality: Quebrada Cramalote (probably a misspelling of Gramalote), Villavicencio, Colombia).

Comments. There could be more than one species included here since no attempt was made to distinguish local populations. The only criteria I used to separate this species was the presence of a black blotch in the dorsal fin, but both S. metae and S. argentea are said to have a dorsal spot. In Vari's (1983) preliminary key, S. argentea is said to have a small caudal spot that doesn't extend onto the caudal peduncle, whereas S. metae is said to have that spot large and extending onto the caudal peduncle. I have observed a wide range of variation in the size of this spot from the same population of curimatids and in some it even extends forward as a lateral stripe. From observations of fish in aquaria it is evident that spot size can vary with the "mood" of the fish. The effects of preservation are also a factor to be considered. Either there is a complex sympatric community of curimatids at most sites or (more likely) this character is simply quite variable.

I have included S. metae as a synonym of C. argentea because no characters useful to distinguish the two were included by Eigenmann in his original description. He simply stated that S. metae greatly resembles S. argentea, differing only in shape of the caudal peduncle and coloration. However, he did not say how caudal peduncle shape differs, and described a color pattern common to many species. If S. argentea is restricted to Trinidad, then the name S. metae would be available for the Orinocan species.

Etymology. ARGENTEA = silvery.

Description

Illustrations. Fig. 275. Géry 1977:232 (The fish pictured as "*Curimata elegans*-group" is similar to this species; Román 1985:138.

Diagnosis. This curimatid can be recognized by the following combination of characters: caudal peduncle with a spot, or horizontally extended blotch; dorsal fin with a black dot; caudal fin scaled only at its base; lateral-line scales about 39.

Size. This is a small species that seldom exceeds 90 mm SL.

Morphology. The body is stocky, and fairly broad for the overall size of the fish, with a deep, robust caudal peduncle. The head and anterior portion of body are conical and the mouth is terminal. The scales are large, and easily visible without magnification. The pectoral fins are placed low on the body and the dorsal fin in positioned on the anterior half of the body. A well developed adipose fin is present. The caudal fin is forked, with equal lobes.

Counts. DR ii10; AR iii8; PR i11; VR i7; LLS about 39; TS 13; GR a total of 38 short rakers on the outer upper and lower arches.

Measurements. GBD 48-56% SL; HL 30% (in smaller specimens) to 50% SL (larger ones); IO 44-50% HL.

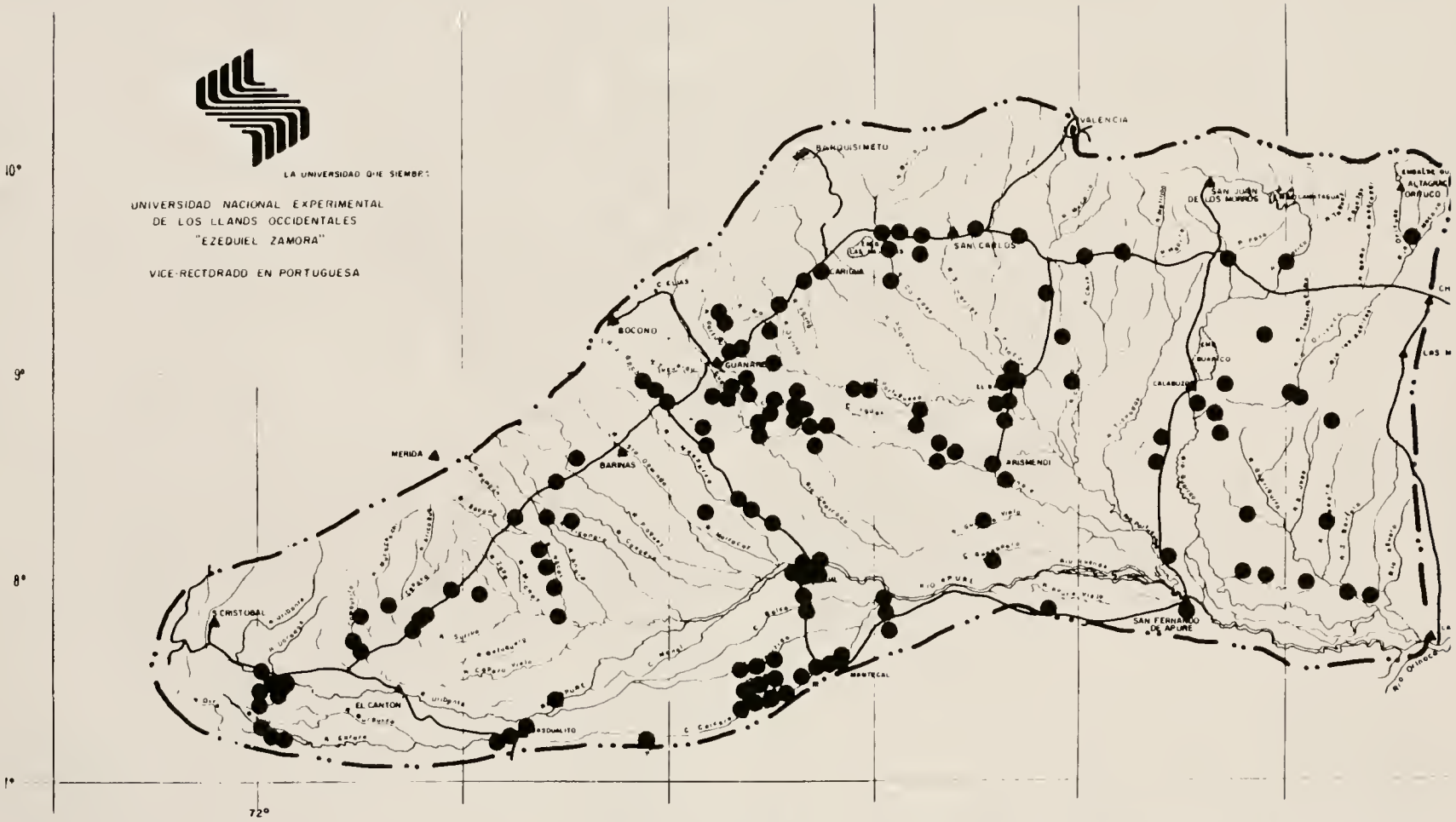
Pigmentation. The body is silvery, often with a horizontally elongated spot on the caudal peduncle. The dorsal fin has black blotch near the middle of its base. The other fins are gray to colorless.

Distribution and Natural History

Range. It occurs on the island of Trinidad and in the Orinoco Basin.

Apure distribution. Map: fig. 276. It occurs throughout the drainage.

Figure 276. Apure drainage distribution of *Steindachnerina argenteus*.



CUENCA DEL RIO APURE

Habitat. It is ubiquitous, and lives in a wide variety of aquatic habitats, but is most common in quiet waters with muddy bottoms, such as prestamos and floodplain lagoons.

Abundance. ABUNDANT. This is the most common curimatid in the Apure drainage.

Number of specimens examined. 4229 from 314 collections.

Food. DETRITIVORE. It feeds on algae, diatoms, bacteria and protozoans from mud and detritus. (K. Winemiller, pers. com.).

Reproduction. Strategy: r2; fecundity: 3528 eggs/female; egg size 0.45 mm. This species matures in about one year, and spawns during the first two months of the rainy season. Individuals probably spawn only once or twice during that time (Winemiller & Taphorn 1989).

Importance. It is used as bait by commercial fishermen.

Cynodontidae

The fishes of the family Cynodontidae, called "payaras" in Venezuela, are all specialized predators adapted to life near the water's surface in large rivers and streams. This small family consists of only four species in two genera (three species of which are present in the Apure drainage). Their large, oblique, superior mouths contain incredibly elongated lower canine teeth (located near the symphysis of the dentaries) that characterize this family and make them easy to recognize. Holes in the upper jaw receive these teeth to allow the drawbridge-like mouth to close. The body plan in this group emphasizes speed. The keeled ventrum characteristic of the payaras serves to reduce water resistance during the rapid pursuit of prey. The low-placed, enlarged pectoral fins provide maneuverability for rapid upward

attacks and braking. The eye is very large. The head and highly distensible mouth are designed for the manipulation of piscine prey. Their main "fishing gear" is a large pair of canines that are used to impale the prey on the first pass. After resistance stops, fish are disengaged from these enameled gaff hooks, flipped around and swallowed whole, usually head first. The main canines are reinforced by numerous additional canines in both jaws, as well as spinous gill rakers. Payaras are common predators present in most llaneran rivers. They readily take baited hooks and even artificial lures, especially silver spoons, but are hard to land because of their hard bony mouths. They are not much valued as food fish because of the numerous small intermuscular bones in the flesh.

Key to the Species of Cynodontidae in the Apure River Drainage.

1a. Origin of dorsal fin well in advance of anal origin...
Hydrolycus scomberoides (fig. 277)

1b. Origin of dorsal fin over or behind anal origin.... ...2

2a. (1b) Anal fin longer, with more than 70 rays; body short, with a "sawed off" look, the greatest body depth about 3.5 in SL (fig. 279); distance between dorsal fins almost twice head length; lateral-line scales about 120...
Rhaphiodon gibbus (fig. 279)

2b. Anal fin shorter, with fewer than 50 rays; body very elongate, greatest body depth about 4.5 in SL (fig. 281); interdorsal distance only about half head length; lateral-line scales 125-150... *Rhaphiodon vulpinus* (fig. 281)

Species Accounts.

Hydrolycus scomberoides (Cuvier) 1817

River Wolf - Payara

Fig. 277. Map: fig. 278. Couplet 1a.

Generic synonymy

Hydrolycus Müller & Troschel 1844:93. (type species: Hidrocyon scomberoides Cuvier 1819, by monotypy; Müller & Troschel 1845:18; Eigenmann 1910:444; Eigenmann 1912:396.

Cynodon (part) Steindachner 1882 (1883):15.

Specific synonymy

Hidrocynus scomberoides Cuvier 1817:168 (type locality: rivers of Brazil), seen.

Hydrocyon scomberoides Cuvier 1819:357, pl. 27, fig. 2 (type locality: rivers of Brazil).

Hydrolycus scomberoides Müller & Troschel 1845:19; Müller & Troschel 1848:19, pl. 5, fig 2.

Cynodon scomberoides Valenciennes in Cuvier & Valenciennes 1849:324; Peters 1877:472 (Calabozo, Venezuela).

Hidrolycus scomberoides Cope 1872:292.

Hydrolicus scomberoides Eigenmann & Allen 1942:273.

Comments. The only other species of this genus, H. pectoralis, occurs in southern Venezuelan in Amazonas Territory. It has fewer lateral-line scales (90 vs 100-125), and more branched anal-fin rays (43-46 vs 33-40) than H. scomberoides.

Etymology. HYDRO = water, LYCUS = wolf; SCOMBEROIDES = like Scomber a genus of mackerel, probably in reference to their overall shape and silvery coloration.

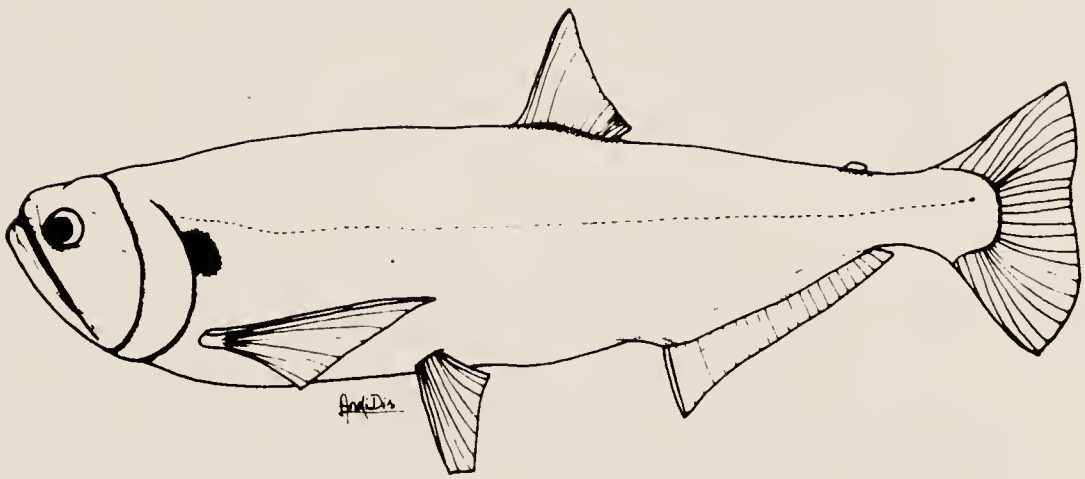


Figure 277. Hydrolycus scomberoides.

Description

Illustrations. Fig. 277; Géry 1977:296; Novoa et al. 1982:fig. 11; Román 1985:153.

Diagnosis. This species has the largest canine teeth of any fish known from the Apure drainage. It can be distinguished from members of the genus Rhaphiodon by means of fin position. The dorsal-fin origin is well in advance of that of the anal fin in this species, but over or behind the anal-fin origin in Rhaphiodon. See Comments above.

Size. This species reaches at least one meter in total length. Novoa et al. (1982) reported a specimen of 560 mm TL with a weight of about 2 kg. This low weight for such a long fish is a reflection of the slender and elongate shape of the species.

Morphology. Although the body is elongate and compressed in relation to fishes of most other families, this is the most robust of the three payaras present in the Apure drainage. The mouth is hinged like a drawbridge. The huge canines of the lower jaw slip into the roof of the skull when the mouth is closed and the other teeth are also conical or caniform and arranged in a single row on both jaws. The dorsal-fin origin is anterior to the anal-fin origin, but posterior to the pelvics. The pectoral fin is set very low on the body, its tip reaches the pelvic-fin insertions. The anal and caudal fins are scaled. The caudal fin is particularly large, evenly lobed, not forked and usually heavily abraded (or perhaps nipped by piranhas?) and rounded. The lateral line is complete, the scales enlarged and obvious. The scales are ctenoid, with serrated edges.

Counts. DR 12; AR 33-40.

Measurements. HL 4.5 in SL; GBD 3.5-4.0 in SL.

Pigmentation. The body and head are silvery There is a large black blotch behind the opercle. The dorsal, pectoral and ventral fins vary, they are sometimes plain translucent white or gray, or white with black edges, or even solid black. The adipose fin is often orange and black.

Distribution and Natural History

Range. It is known from most of tropical South America.

Apure distribution. Map: fig. 278. It is found in most large llaneran rivers and adjacent floodplains.

Habitat. In the Apure drainage, adults of this species have been found mostly in or near large muddy rivers and creeks. Juveniles were taken in the floodplain adjacent to the larger rivers and sometimes from ponds in flooded savannas.

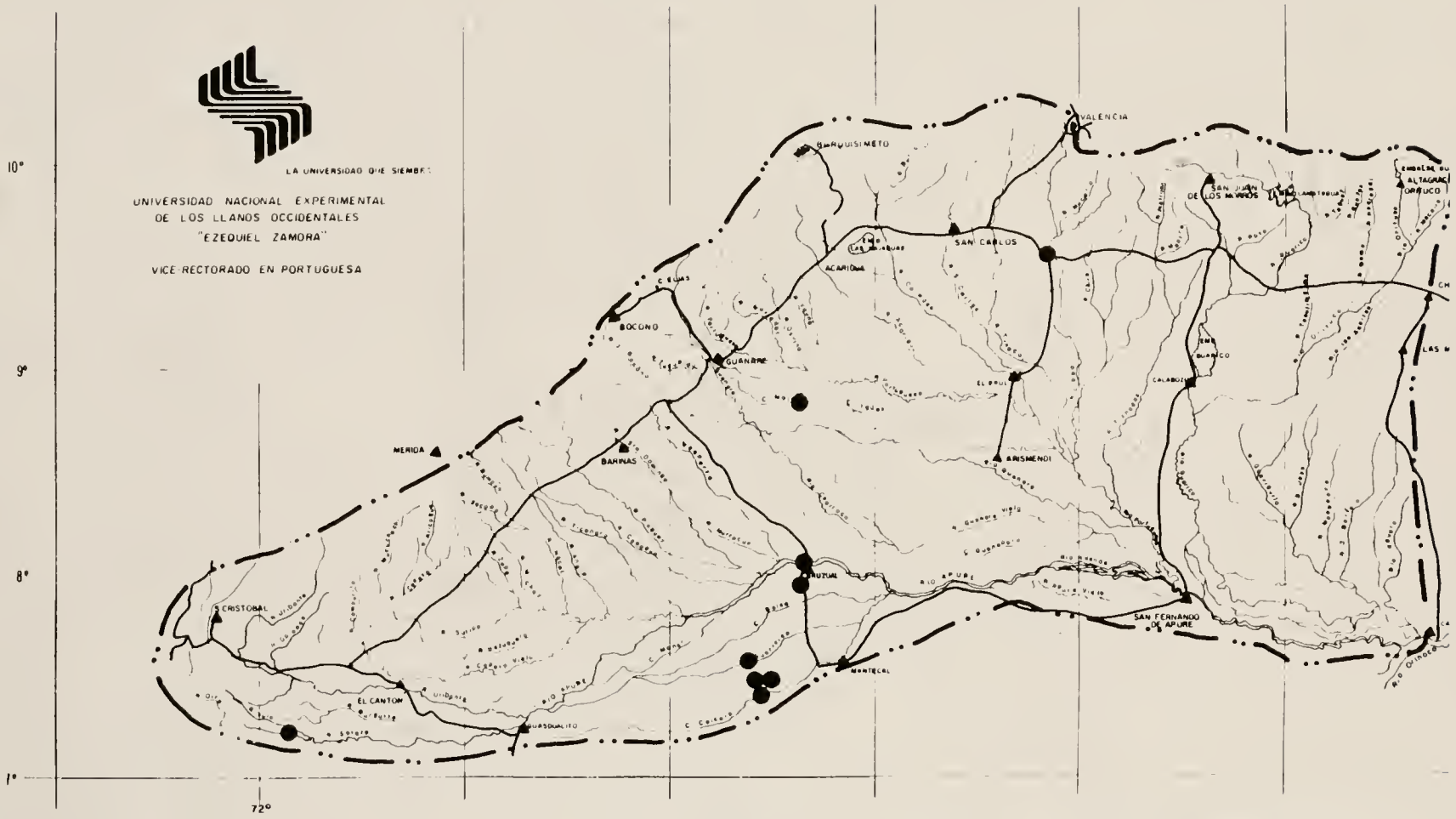
Abundance. COMMON.

Number of specimens examined. 80 from 14 collections.

Food. CARNIVORE. Piscivore. Goulding (1980) found fish and scales in the stomach of this and the closely related *H. pectoralis*. Loose scales probably are a result of failed attacks, since the dentition of this species would seem to preclude scale eating as a usual feeding method.

Reproduction. Strategy: r2. In the aquatic vegetation along the shores in the Apure River, small juveniles (30-60 mm SL) were found in May (the beginning of the rainy season). Novoa et al. (1982) reported the greatest abundance of mature individuals in September (late wet season) for the middle Orinoco fisheries. Thus, breeding may occur at different times in different populations of this species. In the Apure drainage, breeding occurs during the late dry season, or with the first rains in April-June.

Figure 278. Apure drainage distribution of *Hydrolycus scomberoides*.



CUENCA DEL RIO APURE

Esc 1 2 000000

Migrations. They are probable, but not documented.

Importance. It is fished commercially in the Orinoco delta, but is not much valued because of the numerous small intermuscular spines in the flesh, and a tendency to spoil rapidly (Novoa et al. 1982). It is not common in the Apure drainage fish markets.

Rhaphiodon gibbus Spix 1829

Humpbacked River Wolf - Payara Chata

Fig. 279. Map: fig. 280. Couplet 2a.

Generic synonymy

Rhaphiodon Agassiz 1829:76 (type species: Rhaphiodon vulpinus Agassiz 1829, by subsequent designation of Eigenmann 1910:444).

Raphiodon (error) Müller & Troschel 1844:93.

Hydropardus Reinhardt 1849:46 (type species: Hydropardus rapax Reinhardt, by monotypy).

Rhaphiodontichthys Campos 1945:472 (type species: Cynodon vulpinus Spix, by monotypy).

Cynodon Spix in Agassiz 1829:76 (type species: Rhaphiodon gibbus Agassiz = Cynodon gibbus Spix, by subsequent designation of Eigenmann 1910:444).

Camposichthys Travassos 1946:9 (type species: Cynodon gibbus Spix 1829, by original designation.

Specific synonymy

Rhaphiodon gibbus Spix in Agassiz 1829:77 (type locality: rivers of Brazil), not seen.

Raphiodon (error) gibbus Müller & Troschel 1844:94.

Cynodon gibbus Spix in Agassiz 1829:78, pl. 27; Eigenmann 1912:395 (description, synonymy); Fowler 1950:330 (synonymy, distribution).

Cynodon gibbum (error) Eigenmann & Allen 1942:272.

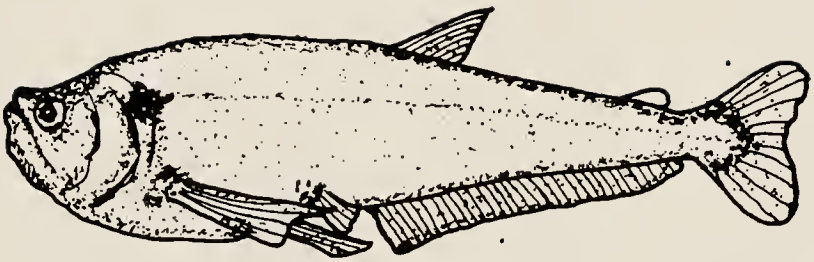


Figure 279. Rhaphiodon gibbus.

Etymology. RHAPHI = saber, ODON = toothed; GIBBUS = hump-backed.

Description

Illustrations. Fig. 279; Géry 1972:54, fig. 5, 2.

Diagnosis. The posterior dorsal-fin origin (placed over or slightly behind the anal-fin origin) will distinguish this species from *Hydrolycus scomberoides*. It differs from *R. vulpinus* in having a much shorter body, but a longer anal fin with over 70 rays (vs fewer than 50).

Size. It can reach about 350 mm SL.

Morphology. These fish are bizarre in appearance. The rear and anterior portions of the body are normal for the family, but the central portion seems to be missing, giving the impression that the tail has been stuck onto the head. The ventral anterior profile is rounded up towards the mouth (possibly as an adaptation to making swift vertical movements to pursue prey sighted at the surface).

Counts. DR 12; AR 73-77; PR i15; VR i7; LLS 120-163; GR 18 on lower arch.

Measurements. HL 4.75-5 in SL; GBD 3.4-3.5 in SL; EYE equal to snout and interorbital, 3.8 in HL.

Pigmentation. This species is mostly silvery, with a rounded humeral spot just behind the upper margin of the opercle.

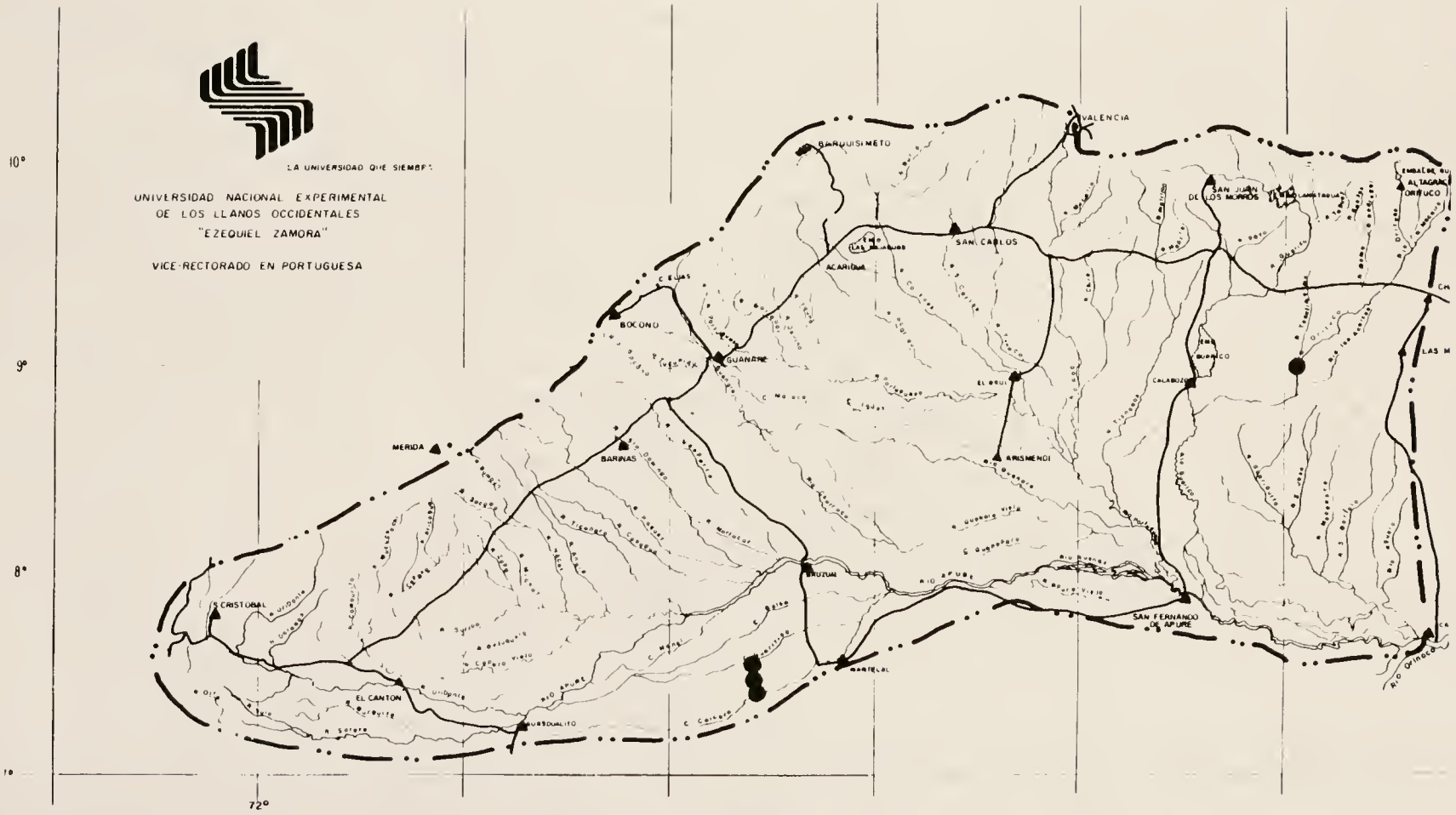
Distribution and Natural History

Range. It is known from most of tropical South America.

Apure distribution. Map: fig. 280. It occurs throughout the llanos.

Habitat. Adults are usually taken from larger rivers, whereas juveniles are taken near shore or from adjacent flooded savannas.

Figure 280. Apure drainage distribution of *Rhaphiodon gibbus*.



CUENCA DEL RIO APURE

Abundance. UNCOMMON.

Number of specimens examined. 22 from 8 collections.

Food. CARNIVORE. Piscivore. It also includes terrestrial insects and other creatures that fall onto the water's surface in its diet.

Reproduction. Strategy r2. The smallest specimens of this species (about 90-100 mm SL) were collected in August and November, from flooded savannas at the modules of Apure. Thus, breeding probably occurs earlier in the rainy season.

Migrations. They are probable but not documented.

Importance. It has no food value, but is sometimes sold as a novelty in the aquarium trade.

Rhaphiodon vulpinus Agassiz 1829

Elongate River Wolf - Payara Machete

Fig. 281. Map: fig. 282. Couplet 2b.

Specific synonymy

Rhaphiodon vulpinus Agassiz 1829:76 (type locality: rivers of Brazil), seen; Fowler 1950: 332-333 (synonymy, distribution).

Raphiodon (error) vulpinus Müller & Troschel 1844:94.

Rhaphiodon vulpnus (error) Travassos 1946:9.

Cynodon vulpinus 1829:77, pl. 26.

Salmo tamuco Natterer in Kner 1860:55 (no locality given).

Hydropardus rapax Reinhardt 1849:46 (type locality: Montevideo).

Rhaphiodontichthys vulpinus Campos 1945: 472.

Comments. The generic name Rhaphiodontichthys Campos sometimes is still employed for this species. The generic status of the two species of Rhaphiodon varies from author to author. Although they are quite

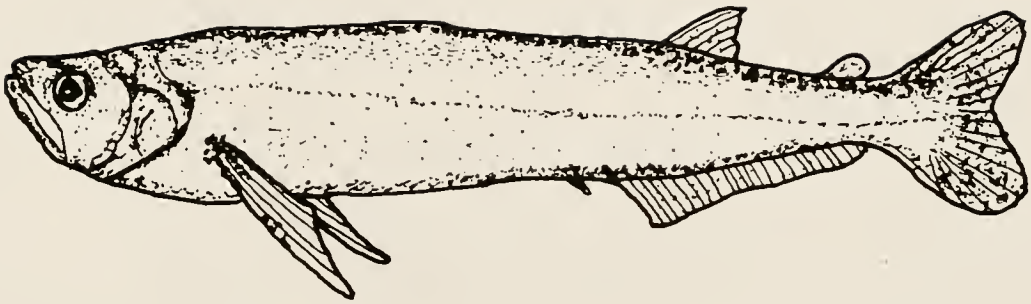


Figure 281. Rhaphiodon vulpinus.

distinctive, there is a tendency to lump them regardless of their numerous differences, perhaps because the genera contain so few species.

Etymology. VULPINUS = fox or dog-like, referring to the canine teeth.

Description

Illustrations. Fig. 281. Géry 1977:297; Goulding 1980:184. Román 1985:153.

Diagnosis. The position of the dorsal-fin origin (posterior to that of the anal fin), and the relatively short anal fin (with fewer than 50 rays) are characteristic of this species.

Size. This is a large species, reaching at least 700 mm SL.

Morphology. The is the most elongate and compressed of the payaras. The anal and caudal fin are covered with a dense sheath of scales. The complete lateral line is slightly raised and emphasized, with the canals divided into dorsal and ventral branches on each scale.

Counts. DR 12; AR about 45; PR i17; VR i7. LLS about 125-170.

Measurements. GBD 4.5 in SL; the distance between he dorsal and adipose fins is only about half the head length.

Pigmentation. The body is silvery with a faint humeral spot behind the upper opercle. The fins are translucent, and sometimes edged with gray.

Distribution and Natural History

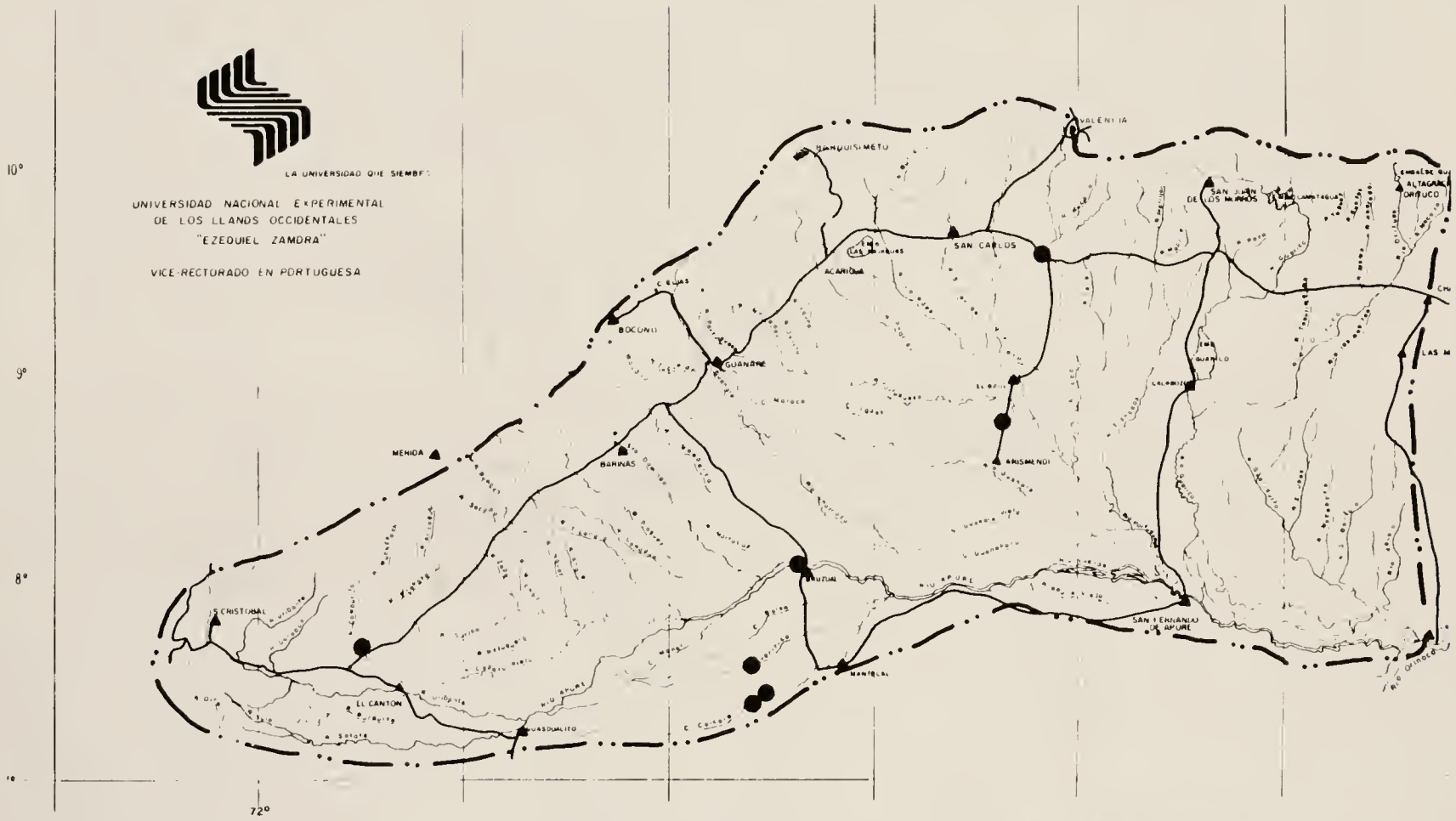
Range. It is known from most of tropical South America.

Apure distribution. Map: fig. 281. It occurs throughout the drainage.

Abundance. COMMON.

Number of specimens examined. 66 from 12 collections.

Figure 282. Apure drainage distribution of *Rhaphiodon vulpinus*.



CUENCA DEL RIO APURE

Food. CARNIVORE. This primarily piscivorous species also takes aquatic insects such as mayfly larvae (Ephemeroptera) (Goulding 1980).

Habitat. It lives in large rivers and streams.

Reproduction. Strategy: r2. Juveniles (30-80 mm SL) were found in aquatic vegetation, along the shores of the Apure River in May. This species probably synchronizes its reproduction with the onset of the rains, as do most llaneran fishes.

Migrations. They are probable but are not documented.

Importance. Although it attains a large size and has a good taste, the numerous spines limit the marketability of this species.

Erythrinidae

Erythrinids are primitive looking fishes, with a long, wide gape, a terete body and small rounded fins. These medium to large-sized predators are mainly piscivorous, though other aquatic organisms are also eaten. When hooked they are quite aggressive, and frequently inflict nasty bites on unwary fishermen. They are readily recognized by the absence of the adipose fin, their cylindrical bodies, large scales (only 30-45 in the lateral-line series), short rounded fins, and large, well-toothed mouths. They have five branchiostegal rays, 10-12 anal-fin rays, and the dorsal-fin origin is anterior to the anal-fin origin. Weitzman (1964) discussed the osteology of this family in comparison with the superficially similar lebiasinids.

The common guabina, Hoplias malabaricus, is similar in appearance to the North American bowfin, and in fact, fills a similar ecological niche. Although it can survive in almost any kind of water, it is most commonly found in the sluggish portions of streams and in lentic

aquatic systems. It is usually found in fairly shallow water near the shore, where its subdued colors and the ability to sit almost perfectly motionless for long periods on the bottom help it go unnoticed amongst the aquatic vegetation and leaf litter. From this position it will ambush unsuspecting small fishes.

The family is a small one, with only three genera and about five species (Nelson 1976). Only three of these, in two genera, inhabit the Apure drainage. Where found, they often are one of the dominant groups of fishes in terms of biomass. This is especially true of Hoplias malabaricus, which is ubiquitous in the Apure drainage.

Key to the Species of Erythrinidae in the Apure River Drainage.

1a. Caudal fin usually plain, with a gray basal crescent, not spotted; dorsal rays 11-12; lateral-line scales 32-37; maxilla without canines, but small conical teeth often present...

Hoplerythrinus unitaeniatus (fig. 283)

1b. Caudal fin usually spotted and blotched; dorsal rays 14-18; lateral-line scales 38 or more; maxilla with 2 or 3 small canines plus a series of conical teeth... Hoplias (2 spp.)... ...2

2a. (1b) Eye large and usually bulging, its upper edge raised above dorsal profile of head; eye diameter longer than snout and measuring only 13-15 times in SL; body color in life dark reddish brown...

Hoplias macrophthalmus (fig. 285)

2b. Eye smaller, its upper edge well below dorsal profile of head; eye diameter shorter than snout length and measuring 16 to 20 times in SL; body color in life usually lighter, tan to gray with darker black and brown blotches and spots...

Hoplias malabaricus (fig. 287)

Species Accounts.

Hoplerythrinus unitaeniatus (Spix) 1829

Aguadulce

Fig. 283. Map: fig. 284. Couplet 1a.

Generic synonymy

Hoplerythrinus Gill 1896:208 (type species: Erythrinus unitaeniatus Spix in Agassiz 1829, by original designation).

Ophiocephalops Fowler 1906:293 (type species: Erythrinus unitaeniatus Spix in Agassiz 1829, by original designation).

Specific synonymy

Erythrinus unitaeniatus Spix in Agassiz 1829:42, pl. 19, (type locality: Río Sâo Francisco, Brazil), seen; Regan 1906:382 (Venez.).

Hoplerythrinus unitaeniatus Gill 1896:208; Eigenmann 1912:418 (synonymy, description); Fowler 1950:360 (synonymy); Géry 1977:103 (key, description).

Erythrinus l-taeniatus (?error) Agassiz 1829:pl. 19.

Hoploerythrinus (error) unitaeniatus Fowler 1915:531.

Erythrinus salvus Spix in Agassiz 1829:41 (type locality: Río Sâo Francisco); Eigenmann & Eigenmann 1891:45.

Erythrinus gronovii Valenciennes in Cuvier & Valenciennes 1846:499, pl. 585 (type locality: Cayenne, Surinam, Brazil); Peters 1877:472 (Calabozo, Venezuela).

Erythrinus vittatus Valenciennes in Cuvier & Valenciennes 1846:499, pl. 551 (type locality: Brazil, Cayenne, Surinam).

Erythrinus kessleri Steindachner 1876:596 (type locality: Bahia, Brazil).

Erythrinus salmoneus Cope 1878:694 (type locality: Peruvian Amazon).

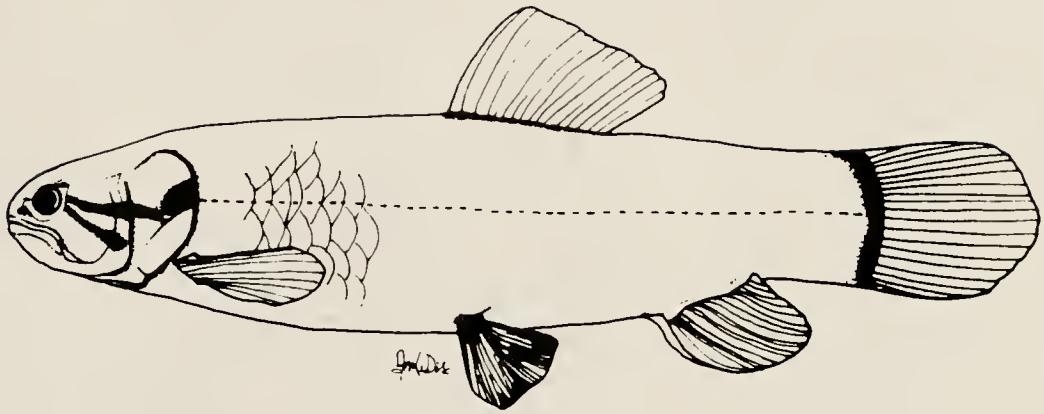


Figure 283. Hoplerythrinus unitaeniatus.

Etymology. HOPL = is from the Greek "Hoplos" for shield or armor, ERYTHRINUS = is a genus of the Erythrinidae; UNI = one, TAENIATUS = spotted.

Description

Illustrations. Fig. 283; Géry 1977:97; Novoa et al. 1982:fig. 10; Román 1985:127.

Diagnosis. This species can be distinguished from species of the genus Hoplias by having fewer dorsal-fin rays (11-12 vs 14-18), fewer lateral-line scales (32-37 vs 38 or more), and in lacking canine teeth on the maxilla.

Size. Novoa et al. (1982) reported that this species can reach 350 mm TL, and a weight of 0.68 kg, but most individuals are smaller, between 80-140 mm SL.

Morphology. This is a cigar-shaped fish with a large mouth and an elongate gape. The posterior tip of the maxilla reaches well beyond the anterior margin of the eye.

Counts. DR 10-12; AR 11; LLS 32-37.

Measurements. The eye diameter measures about 19 times in SL. Eigenmann (1912) reported that the head length measures 3.3-3.5, and the body depth 4.25 in the SL; and that the eye measures 1.5 in the snout length, 6 in the head length, and 2.75 in the interorbital width.

Pigmentation. The characteristic spot on the rear edge of the opercle gives this species its name. There are two or three dark lines radiating from the eye across the preopercle and continuing onto the opercle. Spawning males can be quite colorful. The fins and opercle take on a reddish orange to yellow hue. The body is olive green to bluish in life (light to dark brown in preservative, darkest dorsally),

with a dark lateral stripe and a series or irregular dots and vertical bars that are darkest posteriorly. The dorsal and anal fins are spotted but the pectorals, pelvics and caudal are usually plain, although the caudal fin has a double vertical crescent near its base.

Distribution and Natural History

Range. It occurs in most of tropical and subtropical South America and the island of Trinidad.

Apure distribution. Map: fig. 284. It is widespread in upper and lower llanos, in both black and whitewater systems. It is widely distributed throughout the Apure drainage, but absent from montane tributaries.

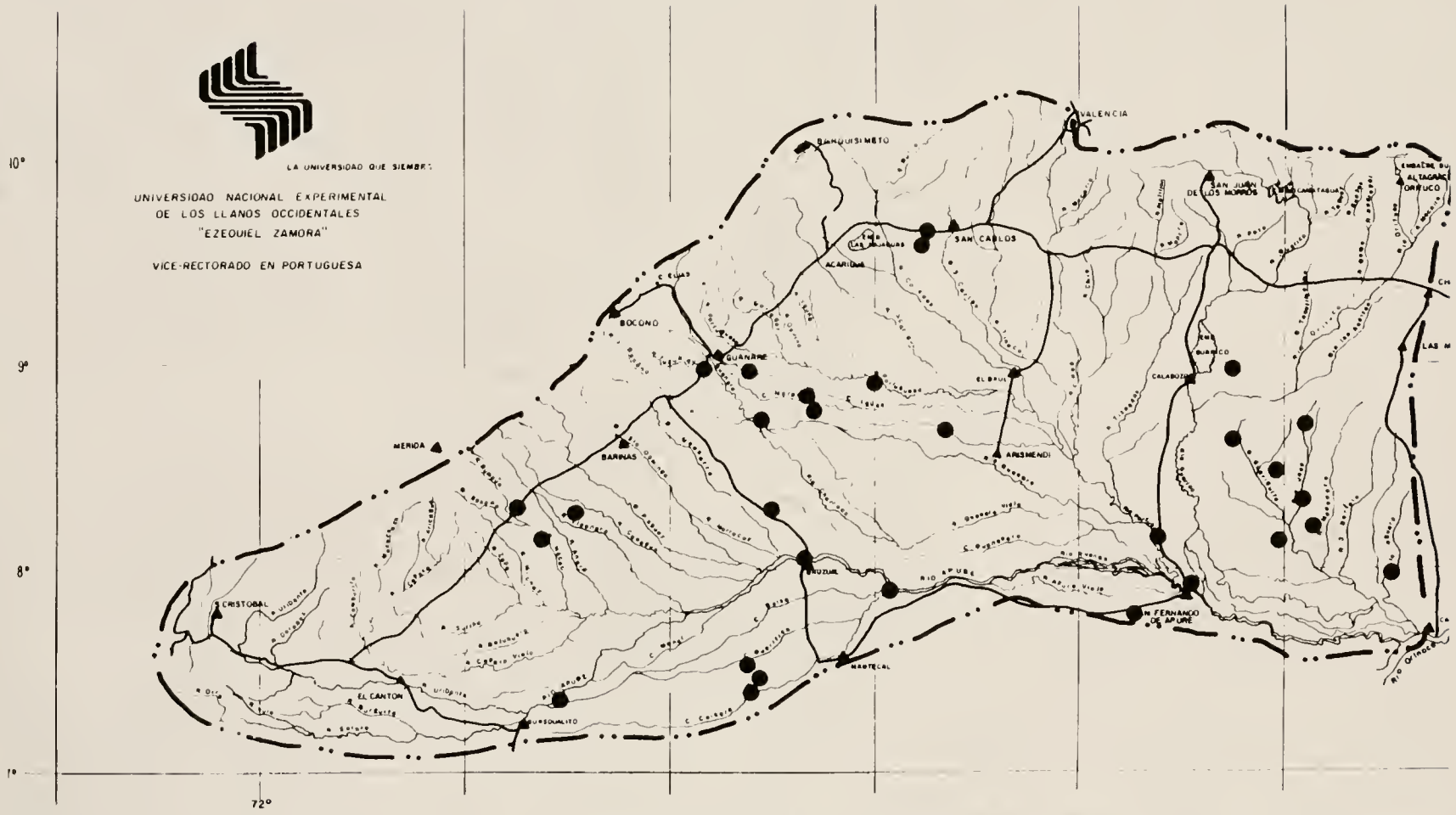
Habitat. It occurs in all sorts of water bodies throughout the llanos, but is most frequently found in bajios, esteros, prestamos and other lentic habitats. This species is known to be a facultative air breather (Rantin & Johansen 1984), an ability that allows it to survive in habitats that are inhospitable for most fishes.

Abundance. COMMON.

Number of specimens examined. 120 specimens from 38 collections.

Food. CARNIVORE. Adult *Hoplerythrinus unitaeniatus* are mostly piscivorous, but also take prawns and aquatic insects; subadults feed mainly on aquatic insects. This species is much more active, and employs a hunting strategy that is totally different from that observed in the *Hoplias* species, which usually lie in wait to ambush prey. This species actively seeks out its prey, patrolling rapidly along the edge of aquatic vegetation in ponds and hovering in the edges of the swift current that flows through culverts under roads. Small fishes straining against the current are actively chased down and swallowed.

Figure 284. Apure drainage distribution of *Hoplerythrinus unitaeniatus*.



CUENCA DEL RIO APURE

Reproduction. Strategy r2; fecundity about 6000 eggs/female; egg diameter 1.5 mm. This species reaches sexual maturity in 12 months; it spawns annually in April to May at the initiation of the rainy season (Winemiller & Taphorn 1989).

Eigenmann (1912) stated that "The anal fin in the breeding males is swollen; the pocket formed by the base of the last anal ray and the sheath of the fin is prominent; a row of scales from the base of this pocket to the second scale above the origin of the anal have the margin deeply incised and covered with a roll of thick skin, which is thence continued down to the anus." I have observed a similar secondary sexual character in *Lebiasina erythrinoides*, which is now included in the family Lebiasinidae, but which was once lumped with erythrinids.

Novoa et al. (1982) noticed that during the spawning season in the Orinoco Delta (April-May) all specimens collected had empty stomachs. This suggests that feeding may be suspended during this time.

Migrations. It is not known to make extensive migrations, but it does move locally to avoid being trapped during time of drought.

Importance. It is consumed locally, and sold in the commercial fishery of the Orinoco Delta. Demand is currently low in the Apure drainage due to the poor quality of the flesh and numerous spines. Sometimes it is sold as a novelty item in the aquarium trade.

Hoplias macrophthalmus (Pellegrin) 1907

Aimara

Fig. 285. Map: fig. 286. Couplet 2a.

Generic synonymy

Hoplias Gill 1903:1016 (type species: *Esox malabaricus* Bloch, by original designation).

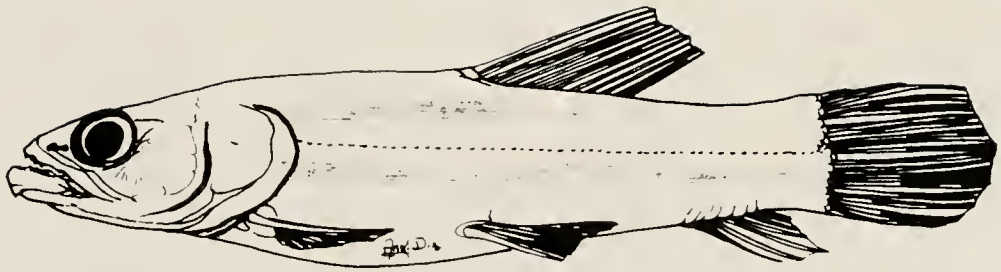


Figure 285. Hoplias macrophthalmus.

Macrodon (not Schinz 1822) Müller 1842:308 (type species: Esox malabaricus Bloch, designated by Eigenmann & Eigenmann 1889:102).

Specific synonymy

Macrodon malabaricus macrophthalmus Pellegrin 1907:26 (type locality: Cayenne: Mélinon, French Guiana), seen.

Hoplias malabaricus microphthalmus [error] Eigenmann 1910:448.

Hoplias malabaricus macrophthalmus Fowler 1950:362 (synonymy).

Hoplias macrophthalmus Eigenmann 1912:413-414 (synonymy, key, description); Mago L. 1970:73; Géry 1977:102. (key, description).

Etymology. HOPLIAS = perhaps from Hoplo, Greek for shield or armor; MACR = large, OPTHALMUS = eye.

Description

Illustrations. Fig. 285; Géry 1977:96, 96 (misidentified as H. malabaricus, illustration of head).

Diagnosis. This species differs from H. malabaricus mainly in relative eye size and pigmentation. The eye is larger, and measures only 13-15 times in the SL (vs 16 or more in H. malabaricus). The eye usually enters the dorsal profile. This species is darkly pigmented, and is sometimes nearly black, whereas H. malabaricus is usually light brown or tan in life and gray in preservative.

Size. This is the giant of the genus. It reaches over 1000 mm.

Morphology. Eigenmann (1912) characterized the genus Hoplias as follows: Caudal rounded; no occipital process; no fontanel; no adipose; mouth large, cheeks entirely covered by suborbitals; teeth all conical; maxilla with a canine and numerous small teeth; premaxilla with a large canine near symphysis and a smaller one toward the sides, and numerous conical teeth; palatines with patches of teeth, the outer series

enlarged; a detached patch of teeth in front of the palatines, maxilla extending beyond the orbit; walls of swim bladder normal; supratemporal plate single. It has large, regularly-ordered scales and a thick cylindrical body.

This species has the eye particularly large and bulging. The lateral line is complete with sometimes multiple canals.

Counts. DR 15-16; AR 10; LLS 43-45; 13-14 scales above and between lateral-line scale rows on opposite sides of body.

Measurements. GBD 4.0-4.3 in SL; HL 3.0-3.3. From Eigenmann (1912): Eye 6.5 in head in specimen of 500 mm (probably total length), 5.0 in specimens 300-400 mm, 4.0 in specimens 50-250 mm; head 2.0 in interorbital in the largest, 1.4 in specimens 300-400 mm; 0.6 in specimens 50-150 mm. Head 3.0-3.25 in standard length; depth 4.0-4.3.

Pigmentation. This fish has a dark reddish brown body with irregular mottling and spotted fins.

Distribution and Natural History

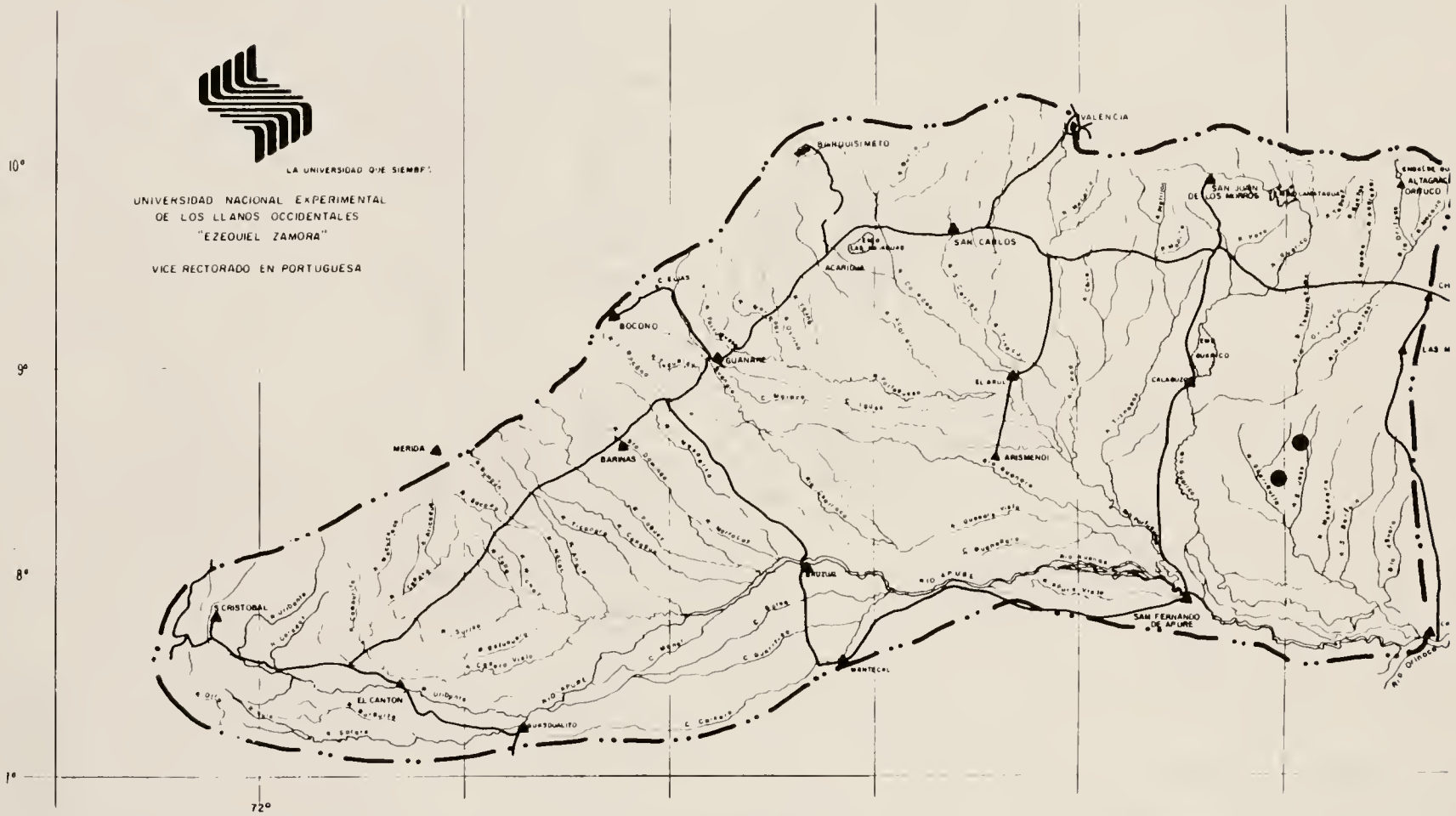
Range. It occurs in the Amazon and Orinoco basins, Guyana, Surinam and French Guiana. In Venezuela this species is usually found in black or clearwater rivers such as the Caroní, Caura, Cinaruco, Ventuari and upper Amazon tributaries.

Apure distribution. Map: fig. 286. It is found only in the SE corner of the Apure drainage.

Habitat. It is exclusively restricted to black or clearwater streams and rivers. This species is much less common in strictly lentic biotopes than its congener.

Abundance. RARE. In the blackwater rivers where this species lives, we have made little fishing effort with hook and line or with the commercial gill nets that are necessary to catch this species.

Figure 286. Apure drainage distribution of *Hoplias macrophthalmus*.



CUENCA DEL RIO APURE

Number of specimens examined. 2 specimens from 2 collections.

Food. CARNIVORE. It is mainly a piscivore, but also eats other aquatic animals. It appears to be somewhat nocturnal.

Reproduction. Probably r2, similar to H. malabaricus.

Migrations. It is not known to migrate long distances, but makes local movements to avoid being trapped in time of drought.

Importance. It is much appreciated as a food fish in eastern Venezuela where it is more abundant, but it is not sold commercially in the Apure drainage.

Hoplias malabaricus (Bloch) 1794

Guabina

Fig. 287. Map: fig. 288. Couplet 2b.

Specific synonymy

Esox malabaricus Bloch 1794:149, pl. 392 (type locality: "Tranquebar" = Tropical South America), seen.

"Tareira" Marcgrave 1648:157 (name in text).

Synodus malabaricus Bloch & Schneider 1801:397.

Macrodon malabaricus Eigenmann & Eigenmann 1889:102 (Brazil, Surinam); Pellegrin 1899:157 (Apure River, Venez.).

Hoplias malabaricus Eigenmann & Kennedy 1903:508 (Brazil); Fowler 1911:433 (Pedernales area, Venez.); Eigenmann 1912:414 (synonymy, key); Pearse 1920:21 (Lake Valencia, Maracay, Venez.); Eigenmann 1920:9 (Tuy, Bué, and Tiquirito rivers, Lake Valencia area, Venez.); Fowler 1931:407 (Caño Guanoco, Venez.); Röhl 1942:384 (Maracaibo, Venez.); Schultz 1944b:308 (L. Maracaibo, Venez.); Mago L. 1970:73; Géry 1977:102 (key, description); Saavedra M. 1984:1 (biology).

Hoplias malabaricus malabaricus Fowler 1950:362 (synonymy).

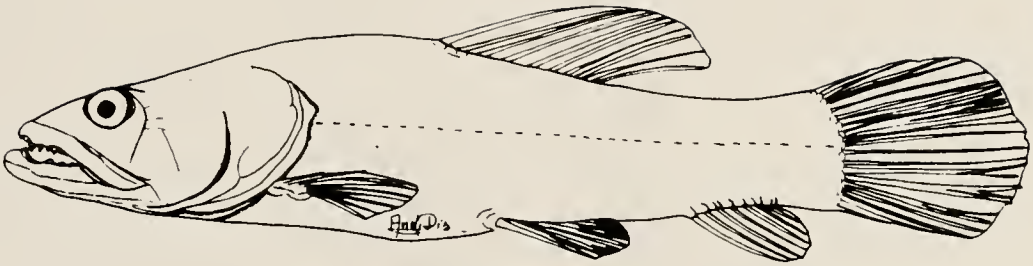


Figure 287. Hoplias malabaricus.

Synodus tareira Bloch & Schneider 1801:398, pl. 79 (type locality: rivers of Brazil).

Macrodon tareira Valenciennes in Cuvier & Valenciennes 1846:508 (Brazil, Venezuela [Maracaibo]).

Synodon palustris Bloch & Schneider 1801:398 (type locality: rivers of Brazil).

Macrodon guavina Valenciennes in Humboldt 1817:179 (type locality: ?Guyana); Cuvier & Valenciennes 1846:527 (Lake Tacarigua, this could be Lake Valencia, Venezuela, since that lake was once called Tacarigua. There is also a brackish lagoon called Tacarigua on the Venezuelan coast southeast of Higuerote. Since the name guavina (or guabina, since in Venezuela Spanish "v" and "b" have the same sound) is still the accepted common name here for this species it is likely that the specimens were from Venezuela).

Erythrinus trahira Spix in Agassiz 1829:44 pl. 18 (type locality: Brazil).

Macrodon trahira Günther 1864:281 (Guyana, Brazil); Lütken 1875:184 (Venez.); Regan 1906:382, pl. 1 (Venez.); Steindachner 1874:524 (Orinoco).

Erythrinus macrodon Agassiz 1829:43, pl. 18. (type locality: "Lago Almada no Estado da Bahia; Río Sâo Francisco," Brazil).

Erythrinus microcephalus Agassiz 1829:44 (type locality: Río San Francisco).

Erythrinus brasiliensis Spix in Agassiz 1829: 45, pl. 20 (type locality: Peruaguacu, Brazil).

Macrodon brasiliensis Müller & Troschel 1844:82.

Macrodon auritus Cuvier & Valenciennes 1846:519 (type locality: Montevideo, [Uruguay]).

Macrodon teres Cuvier & Valenciennes 1846:521 (type locality: Maracaibo [Venez.]).

Macrodon patana Cuvier & Valenciennes 1846:522 (type locality: Cayenne).

Macrodon ferox Gill 1858 (type locality: Trinidad).

Macrodon intermedius Günther 1864:282 (type locality: Río Cipó)

Etymology. MALABARICUS = from Malabar, apparently there was some error in the original locality of the specimens sent to Bloch, since Malabar is a coastal region of SW India on the Arabian sea in Karnataka and Kerala states. The reference to "Tranquebar" given as the type locality in the synonymy is of unknown origin.

Description

Illustrations. Mago L. 1970:259; Géry 1977:97; Román 1985:126.

Diagnosis. This species differs from H. macrophthalmus mainly in relative eye size and pigmentation. The eye measures 16 to 20 times in the SL, and so is relatively smaller than in H. macrophthalmus, in which the eye diameter measures only 13-15 times. The eye does not usually enter into the dorsal profile. This species is usually light brown or tan in life, and gray in preservative. H. macrophthalmus is much darker, and sometimes nearly black.

Size. This species doesn't grow as big as the aimara, but still reaches a respectable 400 mm SL. It is usually taken between 100-250 mm.

Counts. DR 13-15; AR 10-11; LLS 37-43.

Measurements. The following data are from Eigenmann (1912): Head length 3-3.4 in the SL; head depth 4.3 in SL. The eye diameter measures 7 times in the head length of large specimens (200 mm SL or more); 5-6 times in specimens 100-200 mm, 4.3 - 5 times in specimens 50-100 mm. The eye diameter fits 2.4 times in the interorbital width in specimens 300-

400 mm, 1.6-2 in specimens 200-300, 1.5 n specimens 100-200 mm, 1-1.3 in specimens 50-100 mm.

Pigmentation. The fins are usually spotted. As a rule, the body is much lighter in this species than in H. macrophthalmus, gray to tan, with irregular blotches and spots, and the abdomen whitish. However, in some habitats the body can be quite dark, and relative eye size must be used to distinguish the two species.

Distribution and Natural History

Range. It occurs in Central America, and in tropical and subtropical South America as well as on the island of Trinidad.

Apure distribution. Map: fig. 288. It is ubiquitous in the lower Apure drainage, and are absent only from high montane streams.

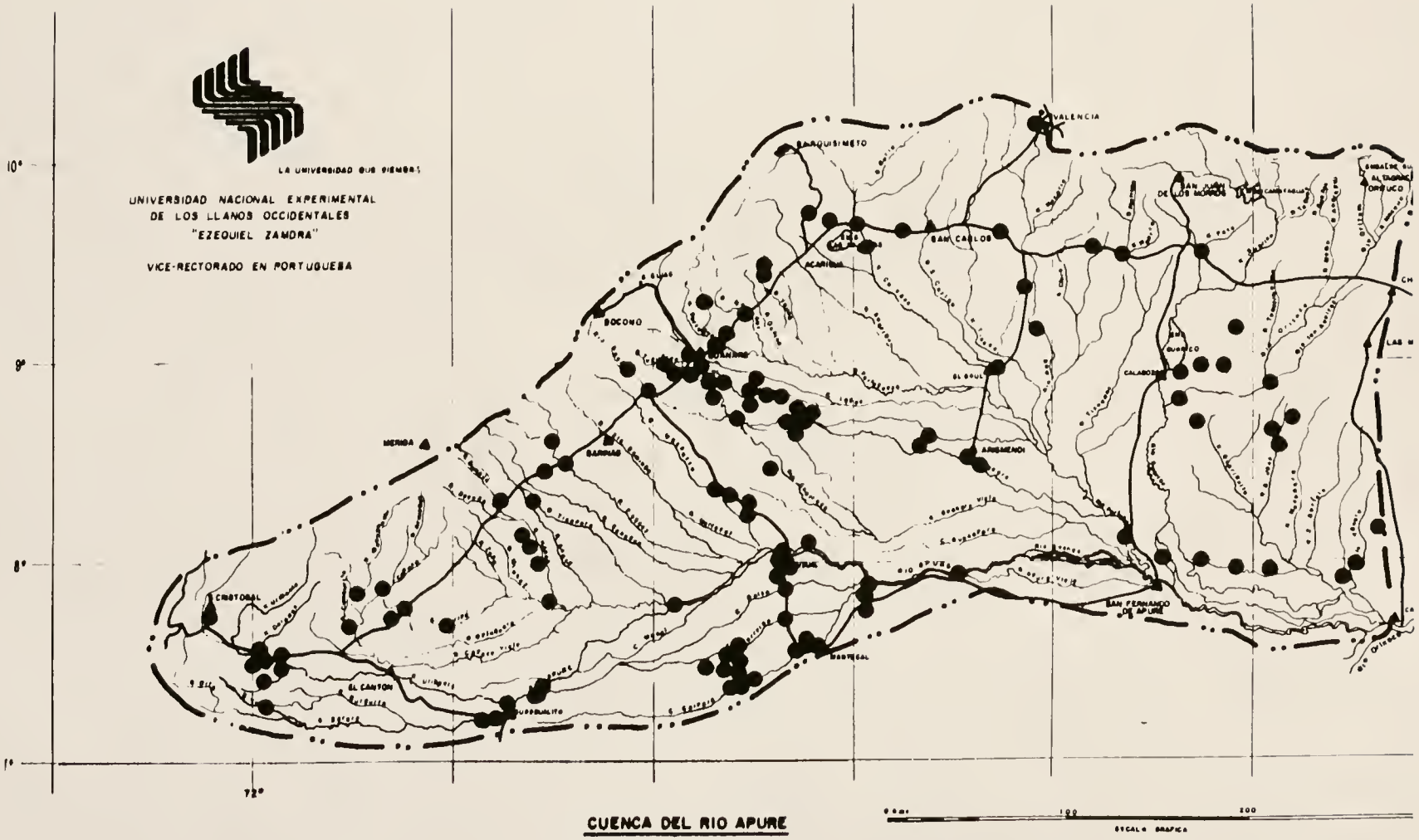
Abundance. ABUNDANT. This species dominates biomass figures in many lentic habitats in the llanos, and is one of the most common llaneran predators (Taphorn & Lilyestrom 1984).

Number of specimens examined. 649 specimens from 252 collections.

Food. CARNIVORE. It is mostly piscivorous, but also takes other aquatic animals such as prawns and aquatic insects (Taphorn & Lilyestrom 1984; Saavedra 1984; Lowe-McConnell 1975, Pearse 1920). Prey are swallowed whole. Its hunting strategy is to sit in ambush, using protective coloring to blend in with vegetation and debris on the bottom in shallow water near shore.

Habitat. It has been found in almost every type of biotope present in the drainage, with the exception of the highest mountain streams, but is especially common in temporary or disturbed areas, and lentic systems in general. Unlike Hoplerythrinus unitaeniatus, which has special respiratory organs that allows it to breath atmospheric air,

Figure 288. Apure drainage distribution of *Hoplias malabaricus*.



CUENCA DEL RIO APURE

this fish is an exclusive water-breather (Rantin & Johansen 1984). Even so, it often inhabits hypoxic water bodies. This is possible due to a high anaerobic capacity, and special behavioral respiratory responses such as increased breath frequency and volume, reduction of activity at low oxygen concentrations, and physiological adjustment of oxygen uptake through the gills. It is tolerant of low salinity water (such as in northern Lake Maracaibo), and pollution (it is one of the few remaining native species in the now nearly totally polluted Lake Valencia).

Reproduction. Strategy r2. This species can reach sexual maturity in 12 months. Spawning occurs chiefly at the beginning of the rainy season from April to June, but can continue throughout the high water season for about five months. The female lays between 2500-3000 eggs (average diameter 2.0 mm) in a shallow depression in shallow water near shore where eggs are guarded by the male. Eggs hatch in about four days, and the yolk sac is absorbed in another ten (von Ihering et al. 1928; Azevedo and Gomes 1943).

Migrations. *H. malabaricus* has been reported to move overland through wet vegetation or mud at night or during rainstorms.

Importance. It is consumed locally if nothing else is available.

Gasteropelecidae

Hatchetfishes are unique in their ability to vibrate their pectoral fins to sustain "flight" when jumping from the water. They get their common name from their greatly expanded coracoid bones that form a characteristic, hatchet-shaped keel. The combination of a superior mouth, large pectoral fins, and a keeled body gives hatchetfishes great maneuverability in the water, an important ability for fishes that feed

at the water's surface in competition with other species. They can often be seen just beneath the water's surface where they patrol for fallen terrestrial insects.

Their "flight" serves as an escape mechanism from predators since they take to the air and scatter when startled. I have seen them leap from the water in aquaria trying to catch insects, but it was not possible to see if they had actually been successful in this regard.

Weitzman (1954, 1960) discussed the osteology and anatomy of the group, as well as the taxonomy. Géry (1977) recognized only eight species in this family, only one of which occurs in the Apure Drainage.

Species Accounts.

Thoracocharax stellatus (Kner) 1859

Silver Hatchetfish - Pechona

Fig. 289. Map: fig. 290.

Generic synonymy

Thoracocharax Fowler 1906:452 (type species: Gasteropelecus stellatus Kner, by original designation).

Specific synonymy

Gasteropelecus stellatus Kner 1859:17, pl. 1, fig. 2 (type locality Río Cujaba), seen; Pellegrin 1899:157 (Apure River, Venez.).

Thoracocharax stellatus Eigenmann & Allen 1942:268 (Orinoco); Schultz 1944b:275 (key); Géry 1977:246.

Etymology. GASTERO = belly, PELECUS = hatchet; STELLATUS = star-like, in reference to the shiny silver color.

Description

Illustrations. Fig. 289; Géry 1977:244; Román 1985:125.

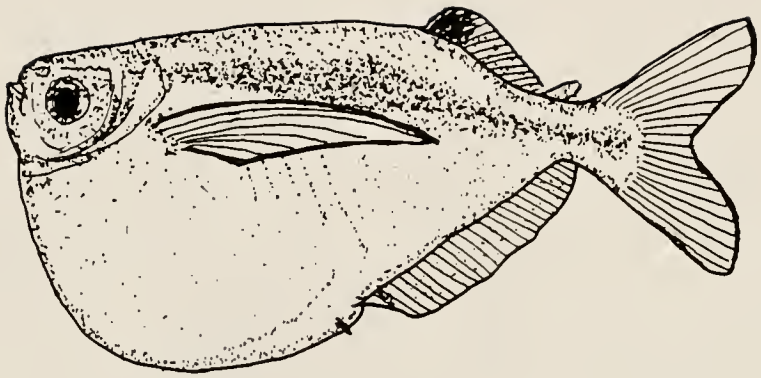


Figure 289. Thoracocharax stellatus.

Diagnosis. The body shape of this species is unique among Apure drainage fishes. It could possibly be confused with small Triportheus, but species of that characid genus are much more elongated.

Size. This is a small species that seldom exceeds 40 mm SL, and is usually found at a much smaller size.

Morphology. The body is extremely compressed, with tremendously expanded coracoids that form a trenchant keel. The lateral line runs at an angle down the sides toward the anal fin. The mouth is superior, with only two or three teeth in the outer row on the premaxilla. An adipose fin is present. The base of the anal fin is sheathed in two to three rows of scales.

Counts. DR iii12; AR iii39-iii41; PR i11; LS 20.

Pigmentation. The body is silvery. The dorsal fin has a black spot. The other fins are colorless.

Distribution and Natural History

Range. It is widespread from Paraguay to Venezuela.

Apure distribution. Map: fig. 290. It occurs in most of the llanos.

Habitat. It lives in quiet creeks, often forested and shady, with cool water, and high visibility. It is frequently observed in open pools in schools, just beneath the surface.

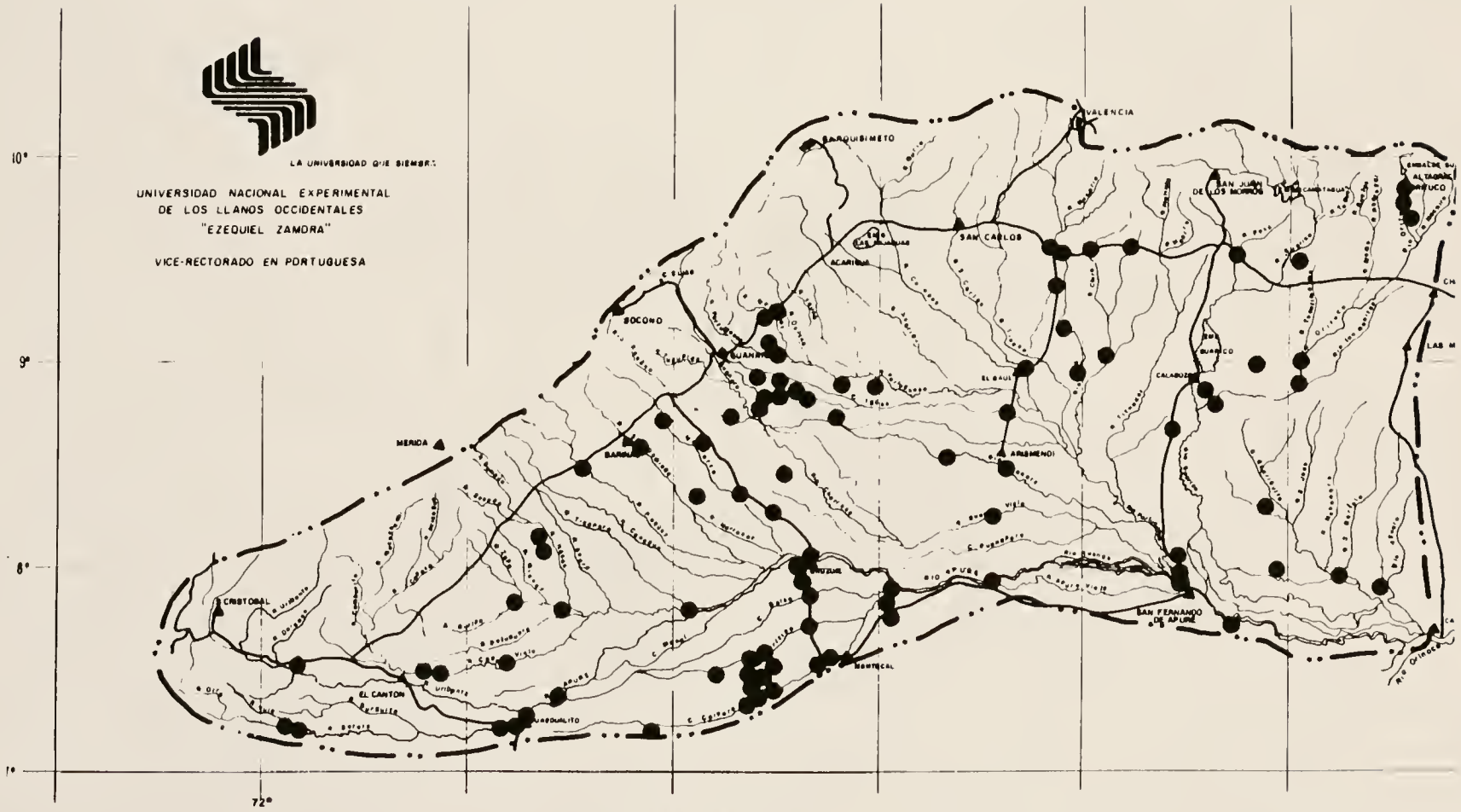
Abundance. ABUNDANT.

Number of specimens examined. 2874 from 165 collections.

Food. CARNIVORE. Their diet includes terrestrial insects (especially ants), aquatic beetles, and small seeds.

Reproduction. Strategy: r2. This species reaches maturity in 12 months. It spawns once or twice during the first two months of the

Figure 290. Apure drainage distribution of *Thoracocharax stellatus*.



CUENCA DEL RIO APURE

rainy season. The 0.8 mm eggs are probably scattered and abandoned. Fecundity is about 750 eggs/female (Winemiller & Taphorn 1989).

Actual spawning behavior has not been observed in this species, but the similar Gasteropelecus maculatus from the Maracaibo Basin reproduced in a 2000 liter aquarium. The parents were fed well, mainly with insects attracted to a light suspended over their tank at night. The fish scattered buoyant eggs throughout the tank and although the adults did not provide any care, they didn't eat their young.

Importance. This fish is a highly sought as an ornamental.

Hemiodontidae

The Hemiodontidae is a small family comprising about five genera and some twenty-five species. Neither the correct spelling for the name of this group nor the correct taxonomic rank (family or subfamily) has yet been determined to all ichthyologists satisfaction. Nelson (1984) classified it as the family Hemiodontidae and included the subfamily Parodontinae (here treated as a family) along with the Hemiodontinae. Vari (1989) attributed full familial rank to this group.

These fishes can be recognized by their sleek streamlined shape and their peculiar multicuspidate teeth (which are present only on the upper jaw in all but one species). Their eye is covered by a heavy adipose eyelid presumably to further reduce drag in the water. A large powerful, forked tail provides propulsion.

Hemiodontids are usually seen in the open water currents of medium-sized, clear or blackwater streams, often near the edges of banks of aquatic vegetation. They are swift, streamlined, strong swimmers that generally occupy midwater to surface niches.

Key to the Apure Drainage Hemiodontidae.

1a. Lateral-line scales more than 110; middle of side with a large rounded black spot at level of tips of depressed dorsal fin rays, which in some specimens continues posteriorly as a faint lateral stripe onto the lower caudal fin lobe...

Hemiodopsis argenteus (fig. 291)

1b. Lateral-line scales 50 or fewer; no rounded black spot on middle of side, a dark black stripe (sometimes broken into horizontally elongate blotches) extending from below tips of depressed dorsal fin rays obliquely onto lower caudal fin lobe...

Hemiodopsis gracilis (fig. 293)

Species Accounts.

Hemiodopsis argenteus Pellegrin 1908

One-Spot Hemiodopsis - Hemiodopsis de Un Punto

Fig. 291. Map: fig. 292. Couplet 1a.

Generic synonymy

Hemiodopsis Fowler 1906:318 (type species *Hemiodus microlepis* Kner, by original designation).

Specific synonymy

Hemiodopsis argenteus Pellegrin 1908:344 (type locality: Orinoco), seen; Böhlke 1955c:7 (color pattern); Mago L. 1970:76; Géry 1977:195 (key).

Types. MNHN 87-769-770 (2 specimens mentioned in original description, but no holotype designated).

Comments. Species identifications are still not reliable in this group, although Géry's (1977) key helps identify species groups. Nelson (1984) considered *Hemiodopsis* to be a junior synonym of *Hemiodus*. I

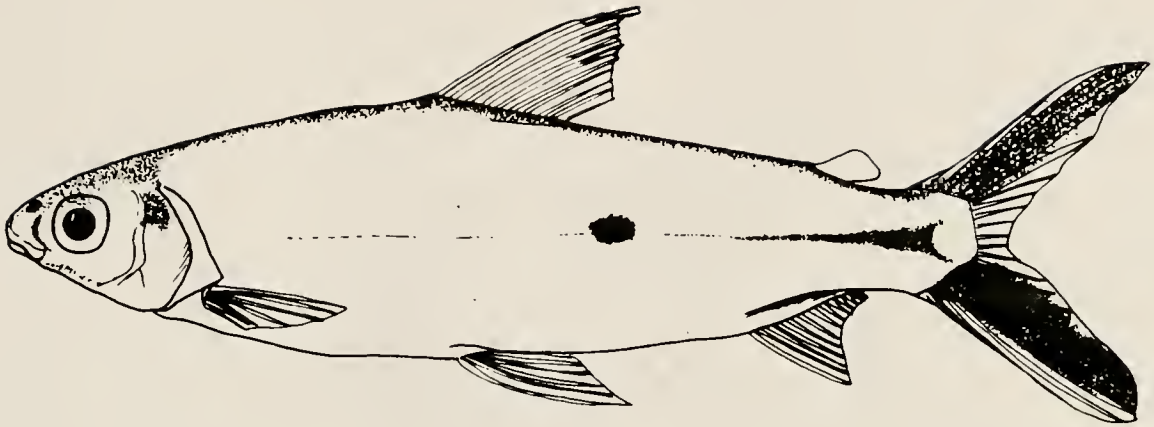


Figure 291. Hemiodopsis argenteus.

have followed the system employed by Géry (1977). Neighboring drainages have several additional species of hemiodontids. Some additional species are to be expected as collecting continues.

Etymology. HEMIODOPSIS = like a Hemiodus; ARGENTEUS = silvery.

Description

Illustrations. Fig. 291; Géry 1977:204 (the photo of a specimen identified as: "Hemiodopsis microlepis-group" is quite similar in the Apure species).

Diagnosis. The completely different pigmentation pattern (a round black dot on the side, as seen in fig. 291) and the numerous small scales in the lateral-line series (over 110 vs less than 50) make it easy to separate this species from H. gracilis, its congener in the Apure drainage.

Size. It can grow to about 150 mm SL.

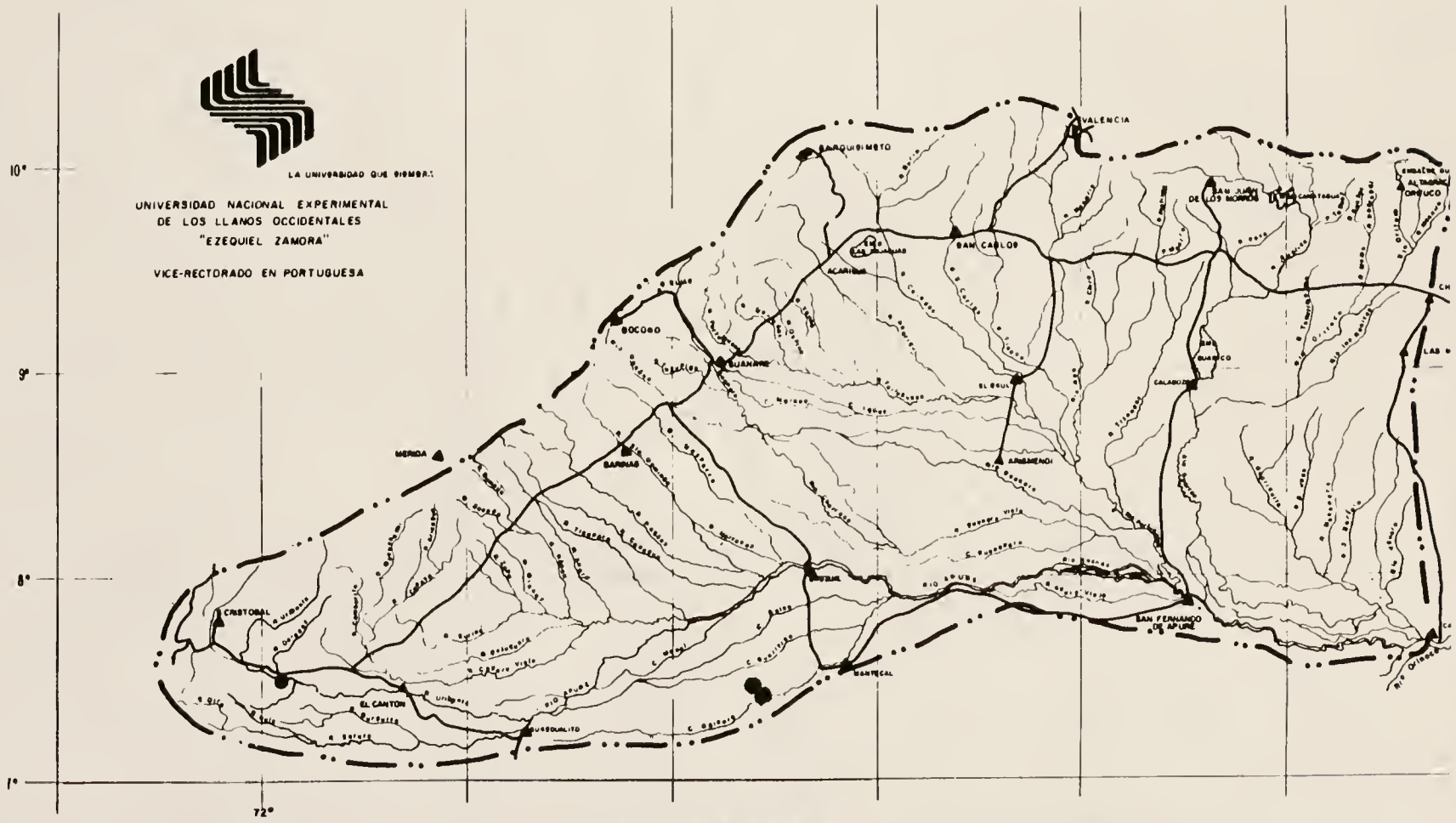
Morphology. The head and body are streamlined and only slightly compressed. The gill membranes free from the isthmus. The eye is covered with a thick adipose eyelid. The teeth are multicuspid and numerous, with a total of about 44 in the upper jaw. An elongate axillary scale is present above the pelvic fins.

Counts. DR ii9; AR iii9; PR i17-i18; VR i10; LLS 118-127; TS about 50.

Measurements. GBD 25-28% SL.

Pigmentation. This fish is silvery blue in life, but turns brown in alcohol. It has a large, black rounded spot on the middle of the side below the level of the tips of the depressed dorsal fin. The spot is about 12 scales high and 12 long, and is followed by a faint lateral stripe that extends out onto the lower caudal fin lobe.

Figure 292. Apure drainage distribution of *Hemiodopsis argenteus*.



CUENCA DEL RIO APURE

Esc 1 2 000000

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 292. So far, this fish has been found only in northern Apure state.

Habitat. It lives in black or clearwater streams that originate on the floodplain, in savanna woodlands.

Abundance. RARE.

Number of specimens examined. 2 from 2 collections. It is probably more abundant (where it occurs) than our collections indicate, since its open water habitat is difficult to sample.

Food. OMNIVORE. Its diet probably includes primarily aquatic vegetation and some aquatic insects.

Importance. Ornamental.

Hemiodopsis gracilis Günther 1864

Half-Stripe Hemiodopsis - Hemiodopsis Medio-rayado

Fig. 293. Map: fig. 294. Couplet 1b.

Specific synonymy

Hemiodopsis gracilis (Günther) 1864:299 (type locality: Rio Cupai, Brazil), seen; Géry 1977:195 (key).

Hemiodus gracilis Fowler 1950:270 (synonymy).

Etymology. GRACILIS = slender.

Description

Illustrations. Fig. 293; Böhlke 1955:5.

Diagnosis. See previous diagnosis.

Size. The largest specimens taken in this study were about 90 mm SL, it probably grows somewhat larger.

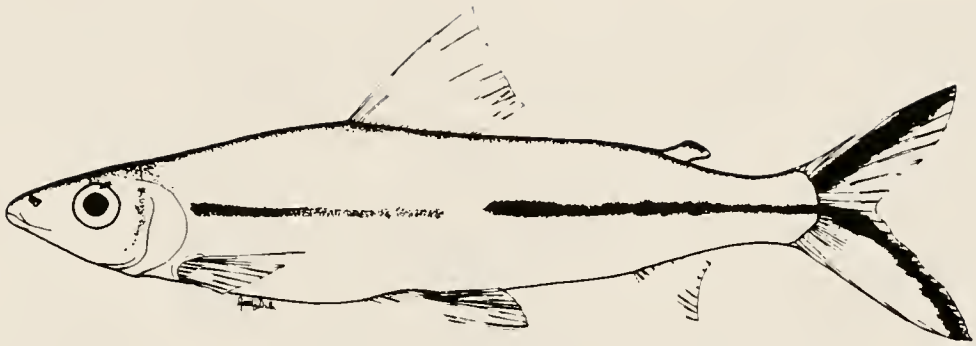
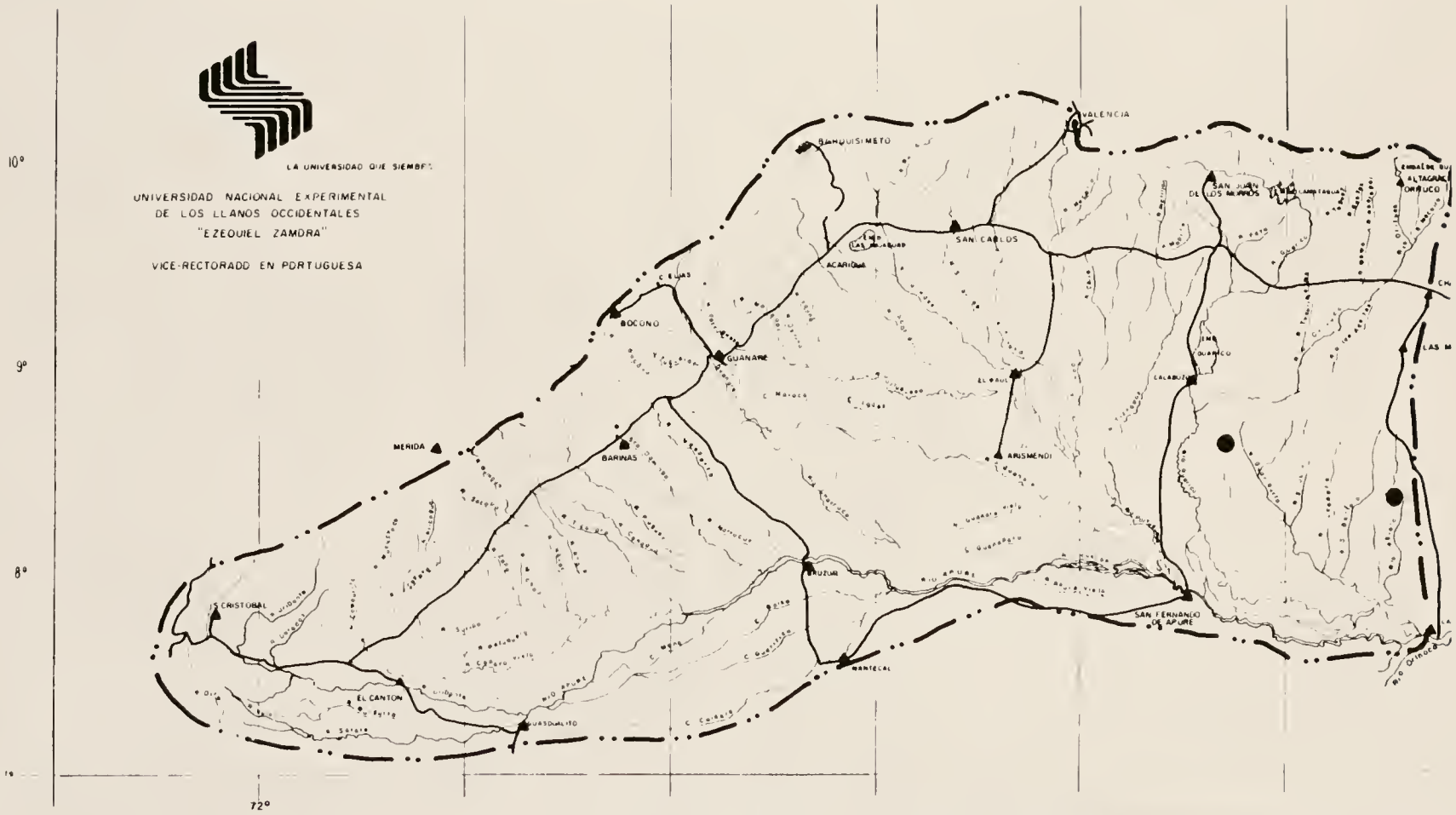


Figure 293. Hemiodopsis gracilis.

Figure 294. Apure drainage distribution of *Hemiodopsis gracilis*.



CUENCA DEL RIO APURE

Esc 1 2 000 000

Morphology. This fish is a sleek study in hydrodynamics. It is elongate, fusiform and nearly cylindrical, and not much compressed. A large fleshy adipose eyelid covers the eye. The teeth are multicuspidate, and number about 20 in the upper jaw.

Counts. DR ii9; AR ii7-ii8; PR i15-i16; VR i10; LLS 45-48; TS 12.

Measurements. GBD 17-21% SL.

Pigmentation. *H. gracilis* is a plain silvery fish, with a black stripe running down the middle of its side from a point below the tips of the depressed dorsal-fin rays and then posteriorly across the caudal peduncle and continuing onto the lower caudal-fin lobe. The other fins are colorless.

Distribution and Natural History

Range. It is known from the Orinoco and Amazon basins.

Apure distribution. Map: fig. 294. It has been found only in the Aguaro River system.

Habitat. It occurs in flowing, open water of blackwater creeks with abundant aquatic vegetation along shore. This species is usually associated with fairly swift currents, sandy bottoms, and gallery forest.

Abundance. RARE.

Number of specimens examined. 31 from 2 collections. It is probably more abundant than our collections indicate, since its open water habitat is difficult to sample.

Food. OMNIVORE. It probably feeds mostly on aquatic vegetation, but may include aquatic insects in its diet as well.

Importance. Ornamental.

Lebiasinidae

This family includes about 50 species, most of which are poorly described (Géry 1977). Weitzman (1964) studied the osteology of the family in detail and compared it to the Erythrinidae. There is a striking superficial similarity between members of the genus Lebiasina and certain erythrinids.

The best known lebiasinids are the pencil fishes, now all included in one genus, Nannostomus (Weitzman & Cobb 1975), but so far no members of that genus have been found in the Apure drainage, although they are present in the nearby blackwater drainages of southern Apure state and from the Guyana Shield, and so might be expected to occur in the blackwater habitats of the Aguaro system. Only three species of lebiasinids, (in the genera Copella, Pyrrhulina, and Lebiasina) are known from the Apure drainage.

The family Lebiasinidae includes two subfamilies, the Lebiasininae and Pyrrhulininae (Géry 1977). The Lebiasininae are fishes of medium size (to 120 mm SL), with a fairly large mouth, a long maxilla and mostly tricuspid teeth. They are predators that inhabit small to medium mountain streams. The Pyrrhulininae are all miniature fishes (seldom over 40 mm SL) with small superior mouths, short maxillas, and conical or multicuspidate incisors. They are most common in heavily vegetated lentic habitats of the llanos.

In most species of this family, sexual dimorphism is well developed. Males are usually more brightly colored and have larger fins than females. Elaborate courtship rituals, and complex breeding behaviors are also exhibited.

Key to the Lebiasinidae of the Apure Drainage.

1a. Adipose fin usually present; dorsal fin sometimes with spot at base, but no spot in center or near tip; caudal fin with black spot at base; a medium-sized fish reaching about 150 mm SL...

Lebiasina erythrinoides (fig. 297)

1b. Adipose fin absent; dorsal fin usually with a dark blotch or spot in center or near tip; caudal fin lacking spot at base; a small fish that seldom exceeds 50 mm SL... ...2

2a. (1b) A wide, dark brown, lateral stripe present from tip of snout to base of tail; anterior margin of maxilla sharply convex, its dorsal tip not slipping under maxilla; gill membranes completely united, but free from isthmus...

Copella metae (fig. 295)

2b. A narrow black lateral stripe (sometimes a series of black spots) from tip of snout to about 7 scales behind the opercle, not continuing to dorsal fin origin; anterior margin of maxilla a simple concave curve as in most fishes, its dorsal tip slipping under maxilla; gill membranes united only anteriorly...

Pyrrhulina lugubris (fig. 299)

Species Accounts.

Copella metae (Eigenmann) 1914

Copella - Voladorita

Fig. 295. Map: fig. 296. Couplet 2a.

Generic synonymy

Copella Myers 1956:12 (type species: *Copeina compta* Myers 1927, by original designation).

Figure 297. Copella metae.

Specific synonymy

Copeina metae Eigenmann 1914:229 (type locality: Barrigona, Río Meta, Colombia, Orinoco Basin), seen; Eigenmann 1922:233, pl. 20, fig. 3. (Barrigón, Colombia).

Copeina eigenmanni Regan (in part) 1912:393 (Bogotá [this type locality is undoubtedly an error since there are no pyrrhulines in Bogotá).

?Copeina arnoldi Schultz 1944b:308 (Caripito, Venezuela).

Types. Holotype: CAS 60494 (IU 13251a). Paratypes: 60495(26) (IU 13251); CAS-SU 24656.

Comments. Mrs. Marilyn Weitzman (pers. com.) kindly confirmed my identification of this species (based on specimens MCNG 1757), but even so, the identification is still tentative pending the final results of her revision of this group.

Etymology. COPELLA = after Edward Drinker Cope 1840-1897, North American zoologist and paleontologist; METAE = from the Río Meta.

Description

Illustrations. Fig. 295; Eigenmann 1922:pl. 20, fig 3.

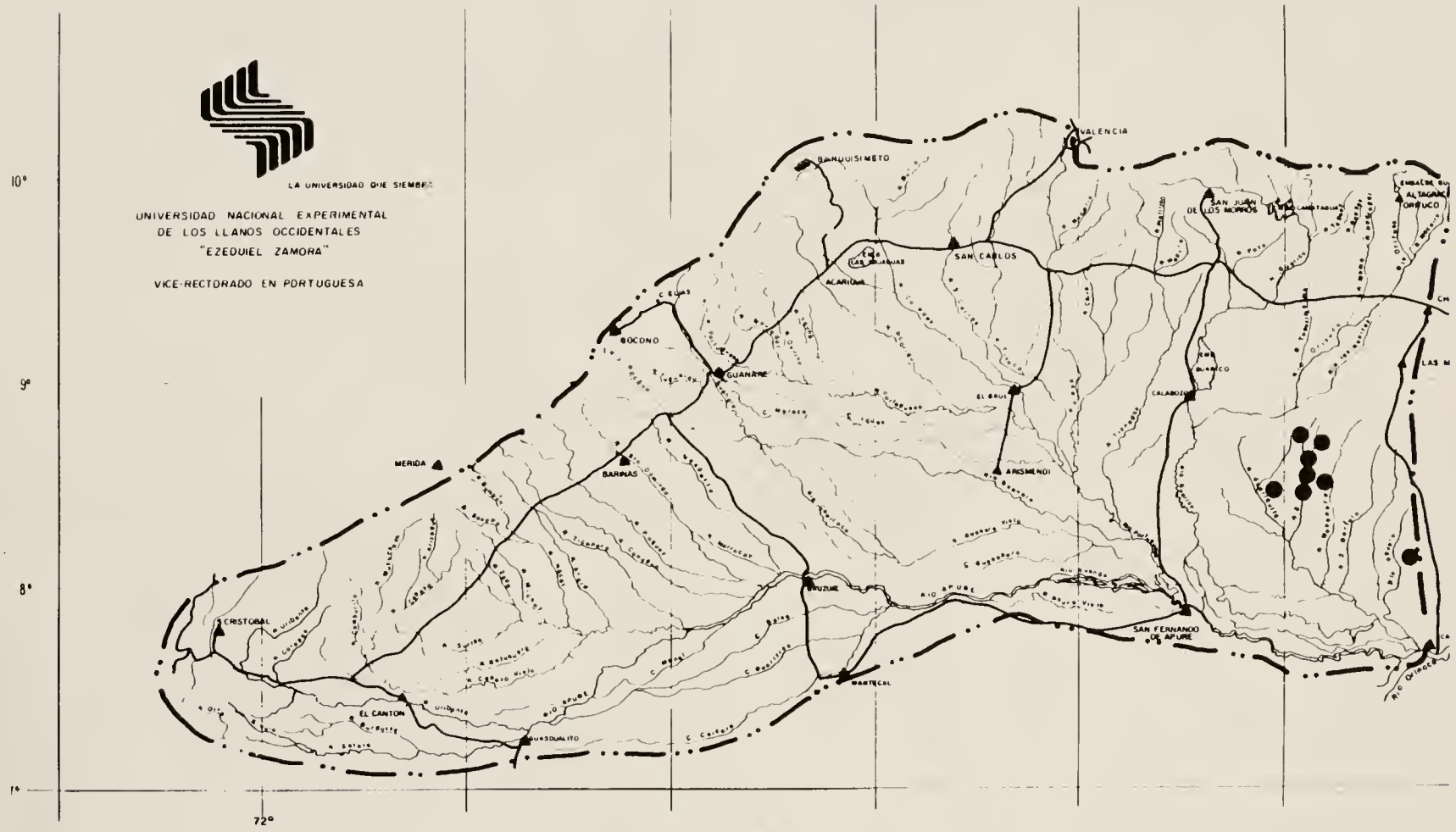
Diagnosis. This fish is easily recognized by the overall pigmentation pattern (fig. 295), which consists mainly of a wide dark stripe down the side. When specimens are faded, the difference in shape of the maxilla is useful (see key).

Size. It seldom exceeds 40 mm SL.

Morphology. The anterior edge of the maxilla is sharply curved. The teeth on premaxilla are in a single row. The gill membranes are completely joined to each other and form a continuous free fold over isthmus.

Counts. DR ii8-ii9; AR ii8, ii9,iii9; LLS 22-24.

Figure 296. Apure drainage distribution of *Copella metae*.



CUENCA DEL RIO APURE

Measurements. HL about 25% SL; GBD 20% SL; eye diameter about equal to the interorbital width, but longer than snout length, and measuring almost 3.0 times in the HL.

Pigmentation. A wide, dark brown lateral stripe extends from the snout to the base of the caudal fin, and is separated from the dark brown dorsum by a lighter tan stripe. The ventrum is cream to white. The dorsal fin has a black blotch, but the other fins are not notably pigmented.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 296. This species is restricted to the far southeastern corner of the Apure Drainage in the Aguaro River system.

Habitat. It occurs in blackwater streams amidst aquatic vegetation.

Abundance. COMMON.

Number of specimens examined. 64 from 9 collections.

Food. MICROCARNIVORE. Terrestrial and aquatic insects taken near the water's surface comprise the principal elements of the diet, however, algae as well as small aquatic crustaceans are also included.

Reproduction. Strategy r1. Its reproductive habits are not known, but sexual dimorphism is pronounced, thus, some sort of courtship and parental care is indicated. Males have a triply curved maxilla, sort of "S" shaped, whereas females have the lower border of the maxilla smoothly curved. Males are also slimmer, with longer fins.

Importance. Ornamental.

Lebiasina erythrinoides (Valenciennes) 1849

Creole Carp - Volador or Carpa Criolla

Fig. 297. Map: fig. 298. Couplet 1a.

Generic synonymy

Lebiasina Valenciennes in Cuvier & Valenciennes 1846:531 (type species: Lebiasina bimaculata Valenciennes, by monotypy).

Piabucina Valenciennes in Cuvier & Valenciennes 1849:161 (type species: Piabucina erythrinoides Valenciennes, by monotypy).

Specific synonymy

Piabucina erythrinoides Valenciennes in Cuvier & Valenciennes 1849:161 (type locality: rivers of Maracaibo, coast of "Parija" [probably the Sierra de Perijá]), seen; Günther 1864:311 (Maracaibo); Eigenmann & Eigenmann 1891:52 (Maracaibo); Eigenmann 1922:125 (Maracaibo); Géry 1977:126 (key); Taphorn & Lilyestrom 1980:336 (synonymy of L. pleurotaenia with L. erythrinoides, biology).

Piabucina pleurotaenia Regan 1903:623 (type locality: Mérida, Venezuela); Schultz 1944b:291, fig. 36 (key, description); Géry 1977:127 (key).

Comments. Although Eigenmann & Allen (1942), Dahl (1971), Géry (1977), and Taphorn & Lilyestrom (1980) all suggested that the genera Lebiasina and Piabucina are not distinct, Piabucina has not "officially" been synonymized with Lebiasina to my knowledge, and so I here propose such a synonymy. Characters previously suggested to be of generic value, such as presence or absence of an adipose fin, and a cellular anterior wall to the air bladder, have been shown to occur in species of both nominal genera, and in any event, do not by themselves warrant generic separation. For example, among the genera of the Characidiidae

Figure 297. Lebiasina erythrinoides.

different species of Elachocharax are characterized by the presence or absence of an adipose fin.

Etymology. LEBIASINA = small "Lebias," apparently a common name of some fish in Valenciennes' time; ERYTHRINOIDES = like Erythrinus, a genus of the family Erythrinidae that is very similar in appearance to this species.

Description

Illustrations. Fig. 297; Taphorn & Lilyestrom 1980:336; Román 1985:129 (misidentified as L. uruyensis

Diagnosis. This species is easily recognized both by the lack of an adipose fin, and by its larger size. Juveniles resemble species of Pyrrhulina.

Size. Males grow to about 190 mm SL, females to about 240 mm SL.

Morphology. This fish is cigar-shaped with rounded fins. The adipose fin is almost always present, but can be lost by injury.

Counts. DR 8-10, mode 10; AR 10-12 mode 11; PR 12-17 mode 14; VR 7-9 mode 8; LS 29-35 mode 32; CPS 11-14 mode 12; PDS 14-16 mode 15; TS 6½ - 8½ mode 7½.

Measurements. Mean values as thousandths of SL from Taphorn & Lilyestrom (1980): PDL 550; HL 255; IO 94; EYE 49.

Pigmentation. In preservative the base color is brown, tan or yellowish. A dark lateral stripe extends from behind the opercle to the caudal peduncle, where it fades before reaching the caudal fin. The caudal fin has a black blotch at its base, about the size of the eye. Above the dark lateral stripe, there is a parallel light area 1½ scales high. Above this light stripe a second dark stripe extends from above the opercle to the region of the dorsal fin. The dorsum is

lighter brown. The sides below the dark lateral stripe and the ventrum are tan. The dorsal fin has a black spot near the base of the first rays. The caudal fin is dusky, and the anal, pelvic and pectoral fins are whitish or translucent.

In life, the fins are orange with white edges, the body is brownish green with rows of yellow and orange spots, and the lateral stripes and caudal spots are jet black. Schultz (1944b) provided additional details.

Distribution and Natural History

Range. It is present in the Maracaibo Basin, the Apure drainage, and some coastal drainages of Venezuela. It is probably present in Colombia in the eastern Magdalena Basin, and the upper Meta (Orinoco) drainage.

Apure distribution. Map: fig. 298. It is restricted to Andean montane and piedmont streams.

Habitat. It occurs in small to medium-sized shady streams in the Andes mountains or piedmont that typically have clear water, fast current and a rocky substrate.

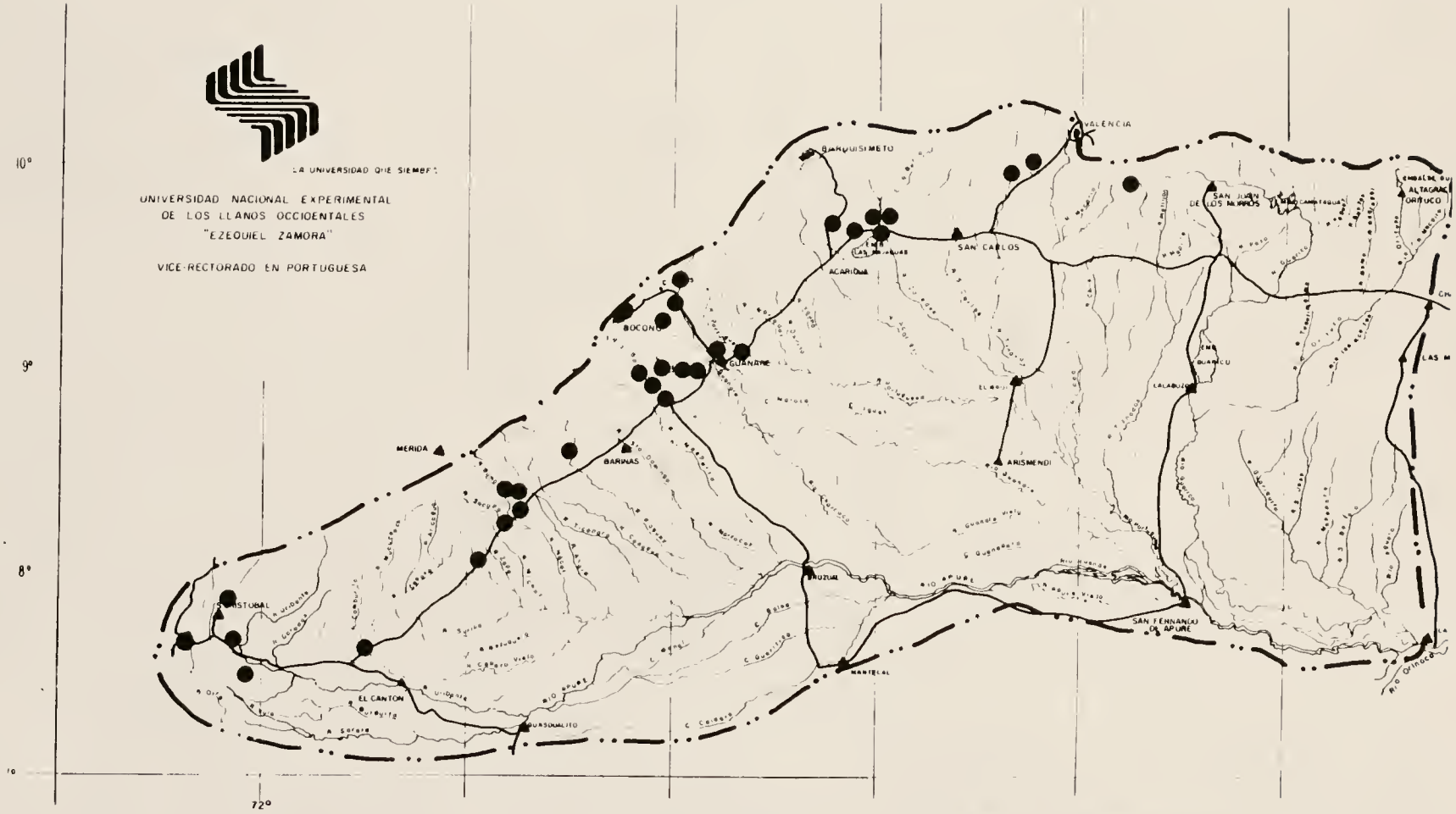
Abundance. COMMON.

Number of specimens examined. 409 from 34 collections.

Food. OMNIVORE. Its diet includes terrestrial arthropods, mainly insects, some aquatic insects, flowers and small fruits (Taphorn & Lilyestrom 1980, K. Winemiller, pers. com.) It also take crustaceans and small fishes. It patrols just beneath the water's surface, waiting for prey to fall in.

Reproduction. Strategy r2. This species reaches sexual maturity in twelve months. The sexes are dimorphic, with males being more

Figure 298. Apure drainage distribution of *Lebiasina erythrinoides*.



CUENCA DEL RIO APURE

ESCALA GRAFICA

colorful, smaller, slimmer, and with larger fins. In particular, males have longer anal fins with longer bases. It also has a row of about seven modified scales (each with a central elevated ridge) on the sides just above the anal fin (the function is unknown, but they are probably used in "contacting" the female during their courtship ritual). The 1.3 mm eggs are scattered with no parental care. Fecundity is about 2700 eggs/female. Machado A.(1974) reported on their spawning in captivity and the development of their larvae. In nature it probably spawns during the first one or two months of the rainy season, and may spawn twice during the season (Winemiller & Taphorn 1989).

Migrations. They are not expected since their habitat, when undisturbed, has water all year round.

Importance. This species is consumed by mountain people, but its relatively small size, mostly carnivorous diet, and low population density severely reduces its value as a commercial food fish. Culture experiments are limited by the near absence of demand for the species outside of its native area. It cannot compete successfully in the market with more desirable species at this time.

Pyrrhulina lugubris Eigenmann 1922

Pyrrhulina - Voladorita

Fig. 299. Map: fig. 300. Couplet 2b.

Generic synonymy

Pyrrhulina Valenciennes *in* Cuvier & Valenciennes 1846:355 (type species: *Pyrrhulina filamentosa* Valenciennes, by monotypy).

Holotaxis Cope 1870:563 (type species: *Holotaxis melanostomus* Cope, by monotypy).

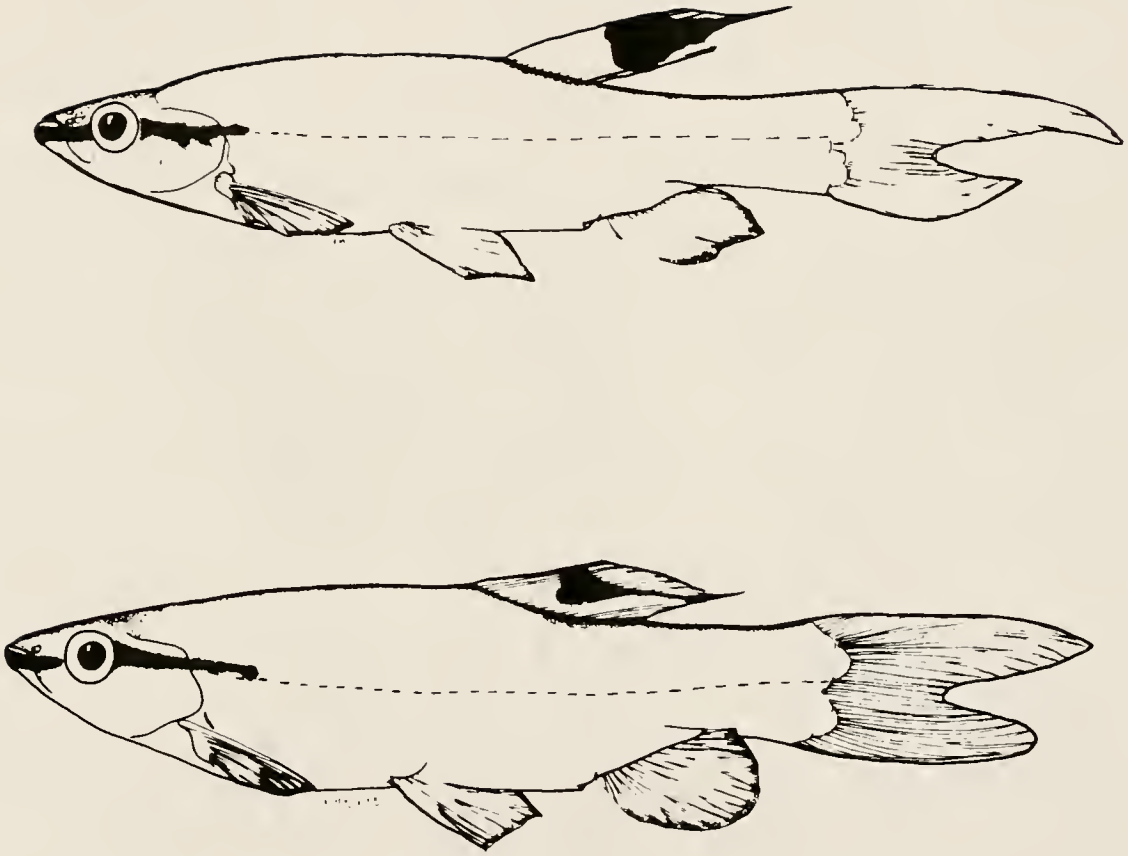


Figure 299. Pyrrhulina lugubris. The male is shown above.

Specific synonymy

Pyrrhulina lugubris Eigenmann 1922:231, pl. 21, fig. 1 (type locality: Barrigón, Río Meta; Villavicencio, Camaral, Colombia (Orinoco Basin), seen; Fowler 1950:348 (synonymy).

?Pyrrhulina semifasciata Regan 1912:390 (type locality: Bogotá).

Pyrrhulina obermulleri Myers 1926:150 (type locality: Iquitos, Peru).

Pyrrhulina filamentosa Fowler 1931:407 (Pitch Lake at Guanoco; Caño Guanoco, Venez.); Schultz 1944b:307 (key); Román 1985:128.

Types. Holotype: IU 15044. Paratypes at CAS: IU 15041, 15042.

Comments. Identification of the species of Pyrrhulina is still extremely difficult. I have not carefully compared specimens from black vs whitewater habitats to see if more than one species is present. Eigenmann stated in the original description that this species was "allied to P. brevis," and Géry (1977) considered it a possible junior synonym of that species.

Etymology. PYRRHO = is from the Greek for fire or red, LINA = small; LUGUBRIS is from the Latin for funereal, probably alluding to the purple body color a traditional mourning color in some cultures.

Description

Illustrations. Fig. 299; Eigenmann 1922:pl. 21, fig. 1; Géry 1977:132; Román 1985:128 (as P. filamentosa).

Diagnosis. This species is distinguished by the following combination of characters: adipose fin absent; lateral stripe short, extending for only a few scales behind the opercle.

Size. It seldom exceeds 60 mm SL.

Morphology. The body is slightly compressed, deeper than in Copella, and with elongate fins. The dorsal, anal and caudal fins have

a basal sheath of scales. The caudal fin is strongly forked. There are no easily-visible lateral line pores.

Counts. DR ii8; AR iii9; PR i12-i13; VR i7; LS 22-23; TS 6, CPS 10.

Measurements. GBD about 25% SL. The HL measures 4-4.3 times in the SL Eigenmann (1922).

Pigmentation. The body is purple in life. A narrow black stripe extends from the snout, passes back through the eye, and continues a few scales behind opercle. The sides are marked with several rows of red or orange spots. The dorsal fin has a dark black blotch and is edged anteriorly in white. The margins of the anal, pectoral and pelvic fins are black in males.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 300. It is found throughout the piedmont and llanos.

Habitat. It is widespread throughout the llanos and Andean piedmont in lentic habitats. It is usually associated with aquatic vegetation in quiet, clear to black waters.

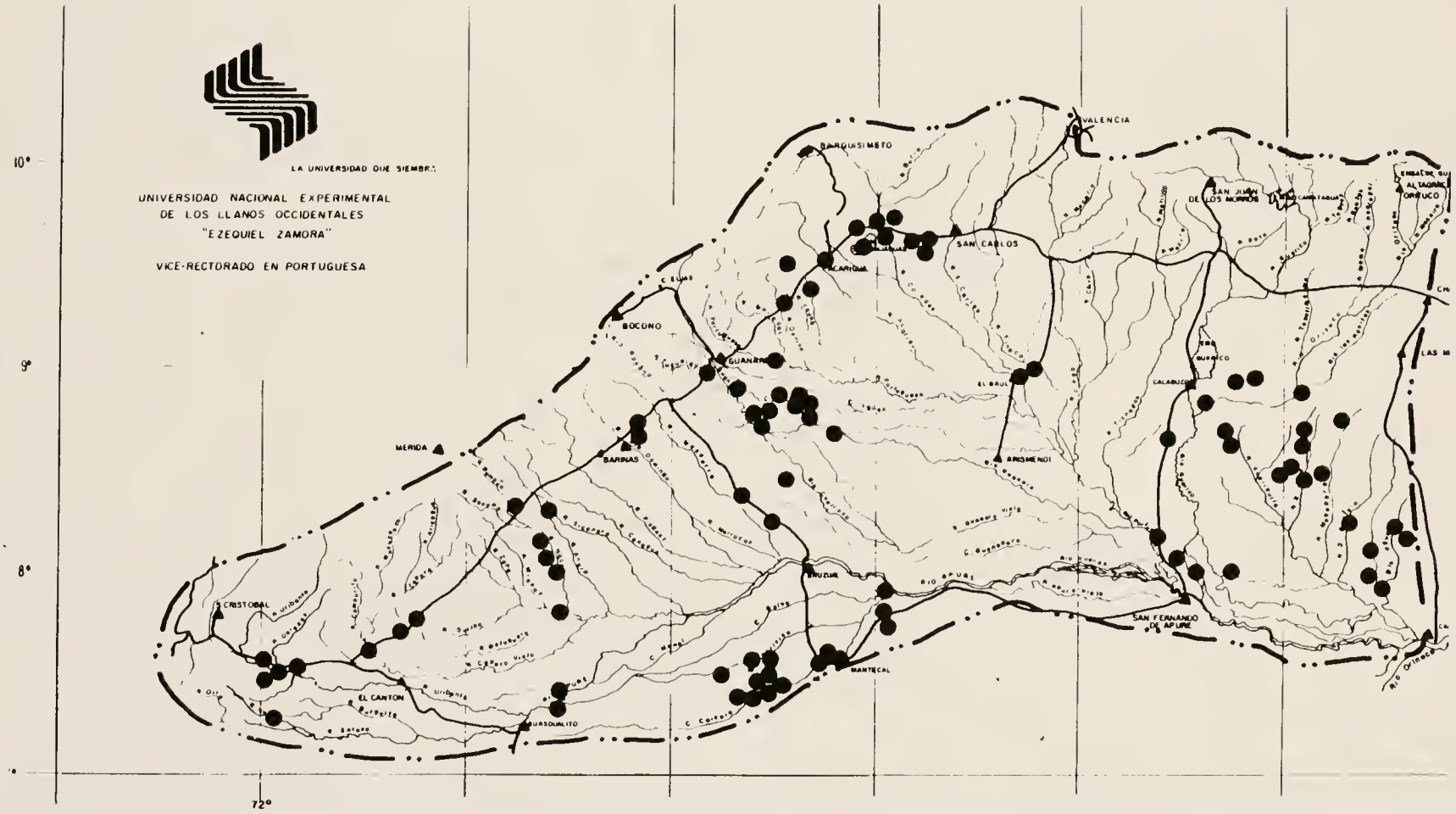
Abundance. COMMON.

Number of specimens examined. 2198 from 159 collections.

Food. OMNIVORE. Their diet includes terrestrial and aquatic insects, microcrustaceans, and algae.

Reproduction. Strategy r1. This species reaches sexual maturity during its first year of life. It reproduces during the first three months of the rainy season. Fecundity is relatively low at only 82 eggs per female. Eggs are about 1 mm in diameter. According to Géry

Figure 300. Apure drainage distribution of *Pyrrhulina* cf *lugubris*.



CUENCA DEL RIO APURE

(1977), the closely related P. brevis spawns on top of a flat stone. The sexual dimorphism observed (generally different color patterns and better developed fins in the more slender males) would suggest that some sort of courtship ritual exists. This species might be considered a K-strategist if adult size, survivorship and longevity were greater.

Importance. This peaceful and colorful aquarium fish is highly sought as an ornamental.

Parodontidae

The Parodontidae are small fishes adapted for a benthic life in fast currents. They have a torpedo shaped, streamlined body, a pointed snout, an inferior or subterminal mouth, and large, low pectoral fins. Fishes of this family lack teeth on the middle in the front portion of the lower jaw. Although one to three small truncate teeth can be present on the proximal end of the dentaries (back inside the mouth), these are not obvious. The alignment and unusual shape of the teeth in the upper jaw is also characteristic. The teeth have long slender stems that are tipped with a wide and highly crenulated cutting edge, with up to 20 individual minute cusps per tooth, that is well adapted for scraping algae and occasionally aquatic invertebrates from the rocky substrate. The teeth project straight back (horizontally) from the premaxillary bones, and so are aligned with the long axis of the body, instead of projecting vertically downward (or perpendicular to the long axis) as in most fishes.

The two genera of Parodontidae are distinguished by the number and arrangement of the premaxillary teeth. In the dozen or so described species of Parodon there are from eight to ten teeth set in a straight

line from one side of the upper jaw to the other. In the three species of Saccodon (none of which occurs in the Apure drainage), there are only six teeth, and they are not arranged in a straight line. The latter genus is further characterized by well developed facial bones that encase the head in bony armor (Géry 1977).

Only two species of Parodon are present in the Apure drainage, and one may represent an undescribed species. I have called the latter Parodon sp. "linea." It lives in the quieter streams of the upper and middle llanos. This habitat is somewhat unusual since most species of Parodontidae inhabit flowing waters over rocky substrates, usually at higher elevations.

Key to the Apure Drainage Parodontidae.

1a. Sides of larger specimens with a series of 13-15 dark vertical bars that are not usually united by a midlateral stripe; snout elongate and conical, its length longer than the horizontal eye diameter; mouth set well back from tip of snout; body more slender, its greatest depth about 27-28% SL; medium-sized fishes reaching over 100 mm SL as adults... Parodon apolinari (fig. 301)

1b. Sides usually with a dark, narrow lateral stripe that extends from the opercle to the base of the caudal-fin rays, the line either broken into a series of dots or absent with a single large spot on caudal peduncle; snout more rounded, its length shorter than the horizontal eye diameter; mouth near tip of snout; body deeper, its greatest depth about 22-24% SL; small fishes seldom exceeding 40 mm SL... Parodon sp. "linea" (fig. 303)

Species Accounts.

Parodon apolinari Myers 1930

Voladorito

Fig. 301. Map: fig. 302. Couplet 1a.

Generic synonymy

Parodon Valenciennes in Cuvier & Valenciennes 1849:51 (type species: Parodon suborbitale Valenciennes, monotypy); Fowler 1950:265 (synonymy).

Apareiodon Eigenmann 1916:71 (type species: Parodon piracicabae Eigenmann, by original designation); Fowler 1950:263; Géry 1977:202 (considered a subgenus of Parodon).

Specific synonymy

Parodon apolinari Myers 1930:66 (type locality: Guaicaramo, Río Guavio, Colombia); 1942:93 (Río Guárico, El Sombrero, state of Guárico, Venez.); Schultz 1944b:287 (key, description); Géry 1977:202 (description).

Types. The species was described from a single specimen SU 23725, (now CAS), an 89 mm male.

Etymology. PAR = equal, ODON tooth, in allusion to the even cusps on the teeth; APOLINARI = in honor of Hermano Apolinar Maria, Director of the Museum at the Instituto de La Salle in Bogotá, who sent the species to Myers.

Description

Illustrations. Fig. 301; Fowler 1943:figs.4-6. Géry 1977: 208 (?misidentified as P. suborbitale).

Diagnosis. The snout is usually longer than the horizontal diameter of the eye. The pigmentation pattern is remarkably similar to that

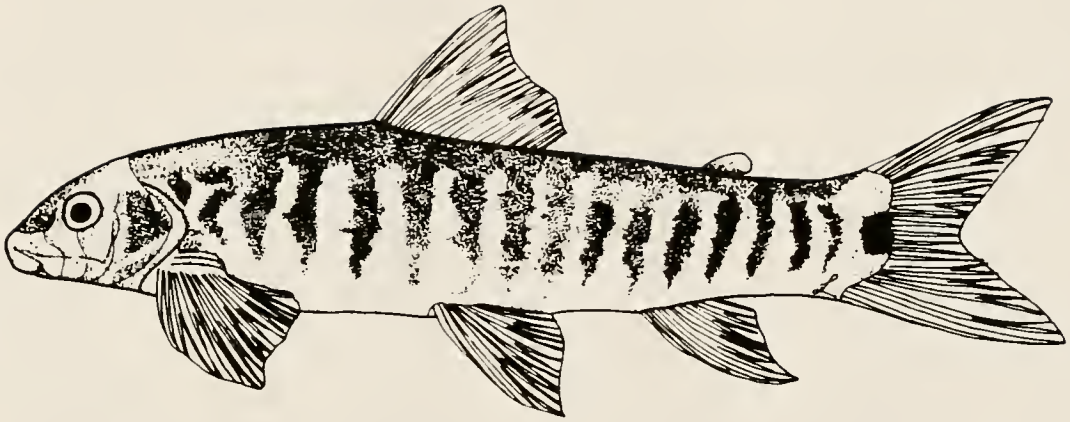


Figure 301. Parodon apolinari.

of young specimens of P. suborbitale, but adults are distinctively marked.

Size. It grows to about 150 mm SL, but is usually found smaller.

Morphology. The body is robust and not much compressed. The head is small and conical. The dorsal-fin origin is positioned anteriorly, much nearer the snout than the caudal-fin base. The mouth is strictly inferior, and the snout is pointed. Each premaxilla has four finely crenelated teeth. The maxillas each have two smaller, similar teeth near the upper end. The dentaries have one to three truncate teeth on the sides, but are toothless along most of their exposed length.

Counts. DR i10; AR i7; PR i14-i15; VR i7; LLS 34; TS 9; CPS 16; PDS 11.

Measurements. HL 5.3 in SL; GBD about 23-25% SL; EYE 4 in HL, 1.7 in snout, 2 in interorbital; IO 2 in HL.

Pigmentation. In preservative the snout and dorsum are brownish, the ventrum lighter tan. The sides are marked with 13-15 vertical bars. The fins are plain.

Distribution and Natural History

Range. It occurs the Colombian and Venezuelan Andes in the Orinoco Basin.

Apure distribution. Map: fig. 302. It is restricted to the Andean piedmont and montane streams.

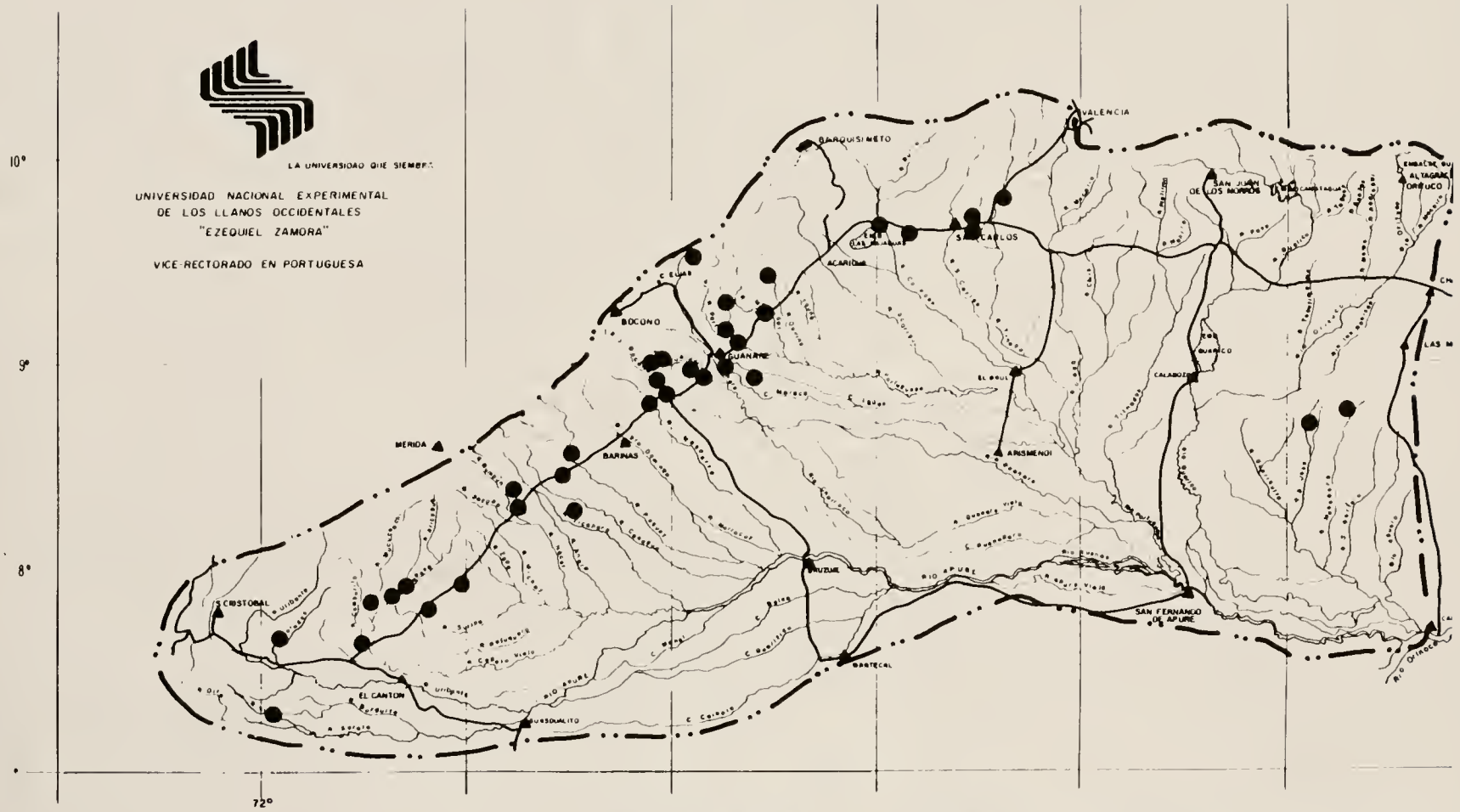
Habitat. It lives in Andean streams and rivers with fast currents, rocky substrates and usually clear water.

Abundance. COMMON.

Number of specimens examined. 229 from 44 collections.

Food. HERBIVORE. It feeds mainly on algae (diatoms and other

Figure 304. Apure drainage distribution of Parodon apolinari.



CUENCA DEL RIO APURE

epibenthic forms), and occasionally on aquatic insects that are presumably found among the vegetable debris that comprises most of its stomach contents. (Alex Flecker, pers. com.)

Reproduction. Strategy probably r2. Males have tubercles on the snout similar to cyprinids and develop a filament on the first dorsal-fin ray (probably a secondary sexual character present only during the breeding season). This would seem to indicate that some sort of courtship ritual is involved.

Importance. Ornamental.

Parodon sp. "linea"

Voladorito

Fig. 303. Map: fig. 304. Couplet 1b.

Comments. This species is similar in overall shape and coloration to *P. suborbitale*, of the Maracaibo Basin, but doesn't seem to grow as large as that species. In *P. suborbitale* the lateral stripe in larger specimens tends to be zigzag instead of straight. There are also differences in snout morphology and eye size. The Apure specimens probably represent a new species.

Description

Illustrations. Fig. 303.

Diagnosis. The snout is shorter and more rounded in this species, its length is less than the horizontal eye diameter. The pigmentation pattern is similar to that of young *P. apolinari*, but is useful for distinguishing adults.

Size. It grows to about 40 mm SL.

Counts. DR ii10; AR ii7; PR i14; VR i7; LLS 36-37; PDS 13; TS 9 1/2.

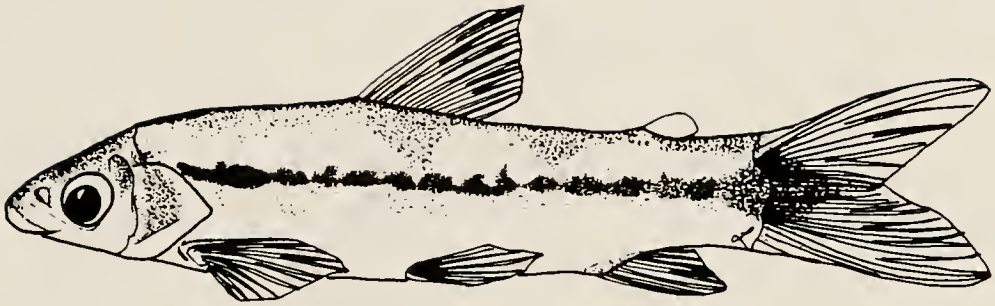


Figure 303. Parodon sp. "linea".

Measurements. GBD about 27-28% SL.

Pigmentation. Pigmentation in this species is somewhat variable but in most specimens I have examined a dark narrow lateral stripe is present. The stripe often extends onto the bases of the central caudal-fin rays. Sometimes the stripe is divided into a series of dots, and in some individuals it connects a series of short vertical bars. For some specimens the pigmentation pattern is very similar to that of young *P. apolinari*, and can cause confusion with the identification of small specimens of the latter. Small individuals of this species sometimes will completely lack the lateral stripe, and show only a lozenge-shaped spot on caudal peduncle, which sometimes extends out onto the central caudal-fin rays.

Distribution and Natural History

Range. It occurs in the Orinoco Basin.

Apure distribution. Map: fig. 304. This species has been collected from sites in both the high and low llanos.

Habitat. As opposed to *P. apolinari*, which is a strictly montane species, this still unidintified species lives in upper llaneran habitats, and is often found in slow-moving, shaded streams.

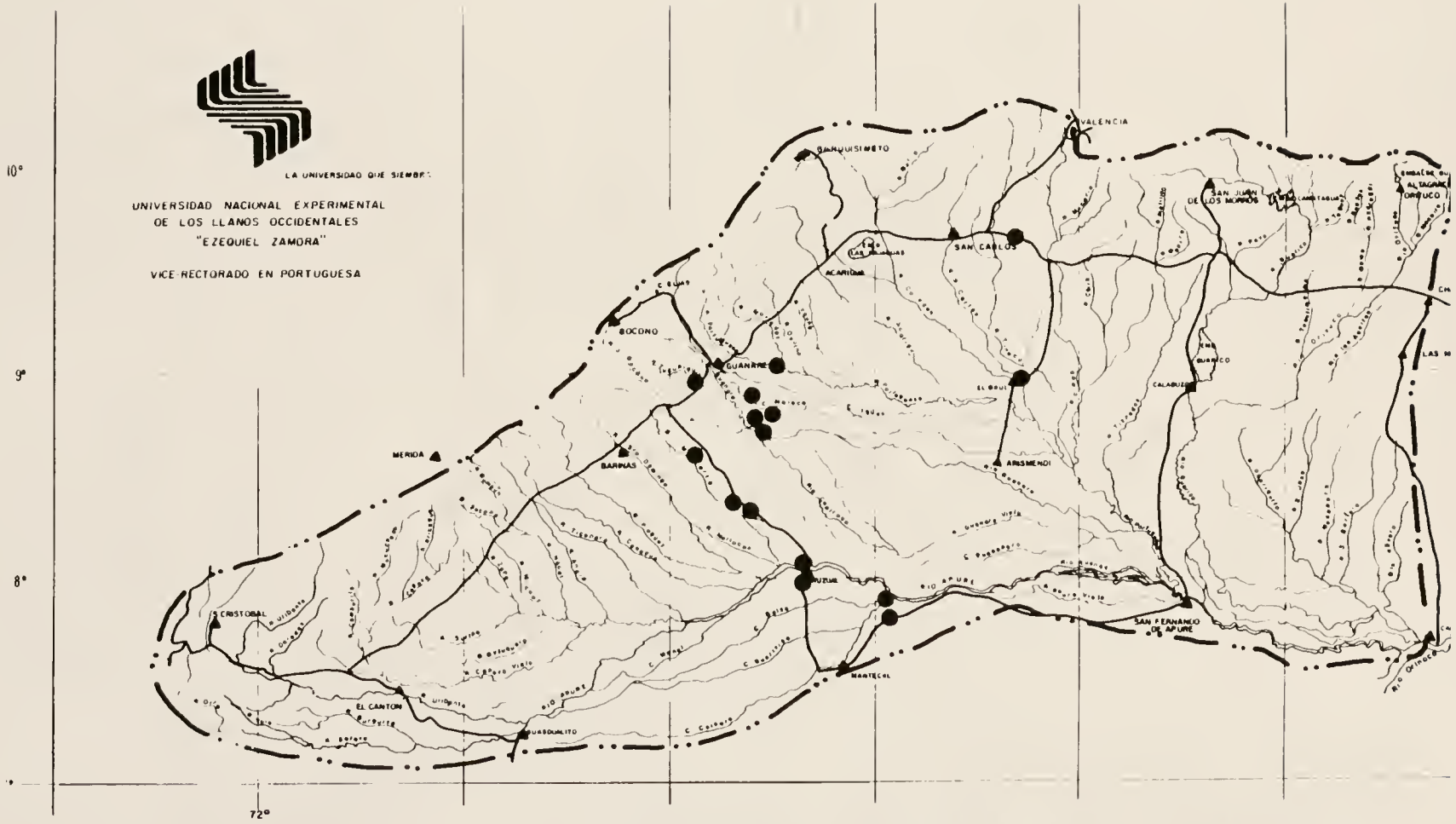
Abundance. COMMON.

Number of specimens examined. 344 from 24 collections.

Food. OMNIVORE. It probably feeds on benthic algae and aquatic insect larvae.

Importance. Ornamental. Since this species has less of an oxygen requirement than *P. apolinari*, it has more potential as an ornamental fish. However, neither species is easily caught, and they are seldom seen for sale in aquarium stores.

Figure 302. Apure drainage distribution of Parodon sp "linea".



CUENCA DEL RIO APURE

Prochilodontidae

Mago L. (1972) revised this family and redescribed the Venezuelan species. He recognized only three genera: Prochilodus (comprising about twenty total species, two of which occur in Venezuela), Semaprochilodus (four total species, two in Venezuela) and Ichthyoelephas (two species, none in Venezuela). Géry (1977) estimated a total of some 25 species. This family includes some of the most abundant and valuable commercial species in South America. In the Apure drainage, they routinely take first place in terms of tons landed (Lilyestrom 1983), and enter into the diets of numerous predatory commercial species, especially the large pimelodid catfishes. They are also very important in the diet of many rural Venezuelans, and in the dry season are the main source of protein for many families. This subsistence fishery is difficult to assess since there are no sales records, but it probably is as large as the commercial fishery.

Prochilodontids have adapted to life on the floodplain by exploiting two rather different food sources, mud (with the associated community of algae, protozoans and bacteria) and plankton. They have large, fleshy, evertible lips covered with tiny teeth, which form a disc that is used for rasping algae from hard substrates, and for sucking detritus from the upper layers of mud. Finely divided, elongate gill rakers permit the consumption of rather small plankters (Mago L. 1972).

Most species make spectacular migrations en masse to move from feeding to spawning grounds or to avoid drought conditions in the dry season. It is during these migrations that most commercial fishing takes place. Habitat loss and deterioration caused by dams, drainage, sedimentation, water contamination from municipal sewers, agricultural

pesticides, herbicides, and fertilizers, and overfishing (in a few areas) has taken its toll on the Apure drainage fisheries. The prochilodontids as obligate migrants, are among the most severely affected (Lilyestrom & Taphorn 1978, Barbarino D. & Taphorn 1989).

The phylogenetic position and family status of the Prochilodontidae has received numerous interpretations and undergone several changes. Roberts (1973), who studied the osteology and phylogenetic relationships, came to the conclusion that these fishes are not close relatives of the Curimatidae, but instead are more closely related to the Anostomidae and Chilodontidae. He found that prochilodontids are most distinctive in characters having to do with oral and branchial dentition, the soft anatomy of the digestive system (they have numerous minute pyloric caecae), and the only moderately coiled gut. The reproductive male's ability to produce sound is also characteristic for the family. However, this position has been challenged by Vari (1983, 1989) who reexamined the families Prochilodontidae, Chilodontidae, Anostomidae and Curimatidae. His position is that the Prochilodontidae and Curimatidae are sister groups and taken together form the sister group to the Chilodontidae and Anostomidae. Each family is monophyletic as demonstrated by the presence of several synapomorphies, most of which deal with specializations of the mouth structure and of the feeding apparatus. Géry (1977) classified the Prochilodinae and Chilodinae as subfamilies of the Curimatidae, and recognized Anostomidae as a distinct family. Nelson (1984) also placed Prochilodontinae as a subfamily of the Curimatidae.

Two different spellings for the family (or subfamily), Prochilodidae and Prochilodontidae, have been used. Géry (1977) is of the opinion that the former is the only name in accordance with the international rules of

zoological nomenclature, but Vari (1983, 1989) continues to use Prochilodontidae.

Key to Apure Drainage Species of Prochilodontidae.

1a. Tail and anal fin plain or with rows of small dots; lateral-line scales 49-65 (usually 53-62); scales ctenoid... *Prochilodus mariae* (fig. 305)

1b. Tail and anal fin with conspicuous black horizontal or oblique bars; lateral-line scales 45-49 (usually 46-48); scales not cycloid... *Semaprochilodus kneri* (fig. 307)

Species Accounts.

Prochilodus mariae Eigenmann 1922

Coporo, Bocachica

Fig. 305. Map: fig. 306. Couplet 1a.

Generic synonymy

Prochilodus Agassiz 1829:62 (type species: *Prochilodus argenteus* Agassiz, = *Salmo marcgravii* Walbaum, by subsequent designation of Eigenmann 1910:424).

Chilomyzon Fowler 1906:309 (type species: *Prochilodus steindachneri* Fowler, by original designation).

Specific synonymy

Prochilodus mariae Eigenmann 1922:231, pl. 20, fig. 2 (type locality: Colombia, Barrigón, Río Meta), seen; Mago L. 1972:48 (family review).

Prochilodus brama (not of Valenciennes) Peters 1877:472 (Calabozo, Venezuela).

Types. Holotype: CAS 15150. Paratypes: CAS 23942(2).

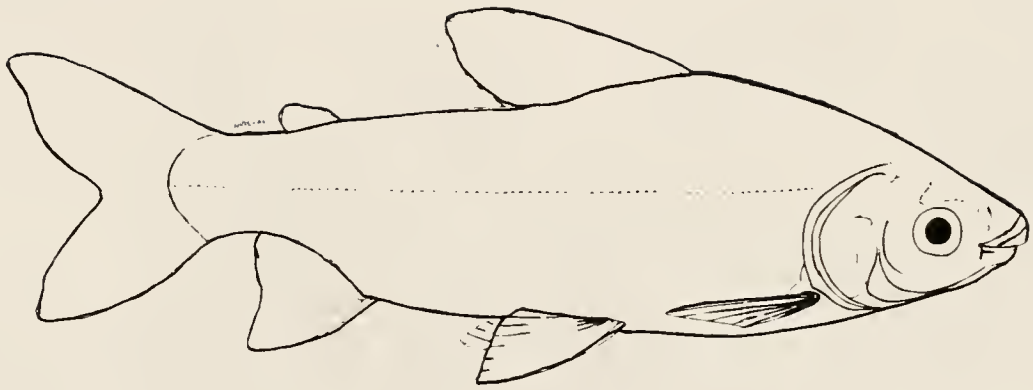


Figure 305. Prochilodus mariae.

Etymology. PRO = in front of, or projecting, CHIL = lips, ODUS = teeth, thus "teeth projecting from lips"; MARIAE = the meaning was not explained in the original description.

Description

Illustrations. Fig. 305; Cervigón in Novoa et al. 1982:fig. 12; Lilyestrom 1983:10; Román 1985:132.

Diagnosis. This is the only Prochilodus species in the Apure drainage. P. rubrotaeniatus, which is present in the lower Orinoco, is characterized by fewer lateral-line scales (41-45 vs 49-65). Prochilodontids can be differentiated from the superficially similar curimatids by the presence of fine teeth (sometimes visible only with magnification) on the margins of the protrusible disc-shaped, fleshy lips. P. mariae is easily distinguished from Semaprochilodus kneri by the absence of black stripes on the tail and the higher lateral-line scale count. Small specimens, or old, faded prochilodontid specimens often lack pigmentation. For such material lateral-line scale counts should be used to assure correct identification.

Size. It grows to about 350 mm SL, but is usually captured much smaller. This species enters the commercial catch when it reaches about 200 mm.

Morphology. The body is fusiform, but slightly compressed. The lips have fine rounded teeth along their outer margins. The abdomen is rounded, and the postventral region is trenchant but not keeled.

Counts. DR 11-12; AR 11; LLS 49-65; TS 18-22; PDS 15-22.

Measurements. GBD 2.3-3.1 in SL.

Pigmentation. The base color is silvery to bluish gray. The dorsum is crossed by eight or more vertical bars, which are more obvious

under and in front of the dorsal fin. The sides have dark, horizontal zigzag lines (between the rows of scales) which are most conspicuous behind the level of the dorsal fin. The abdomen is white. The dorsal and caudal fins have spots which are sometimes arranged in vertical wavy lines.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

Apure distribution. Map: fig. 306. The coporo is ubiquitous in the Apure drainage, though local abundance varies seasonally because of migrations.

Habitat. The migration of this species carries it through almost all habitats in mountains, piedmont and llanos. It passes the wet season on the flooded savannas in lentic water bodies (esteros and bajios). As the dry season begins, the great majority of the population moves upstream to the Andean foothills and mountains, where it remains until the rains return. It travels high up into the mountains and into surprisingly small creeks with barely any water.

Abundance. ABUNDANT.

Number of specimens examined. 346 from 112 sites. This species is so common that it was seldom preserved. Thus, the number of sites indicated on the distribution map do not reflect its true abundance.

Food. ILIOPHAGE. The diet includes protozoans and bacteria from mud and detritus, epibenthic algae, and plankton.

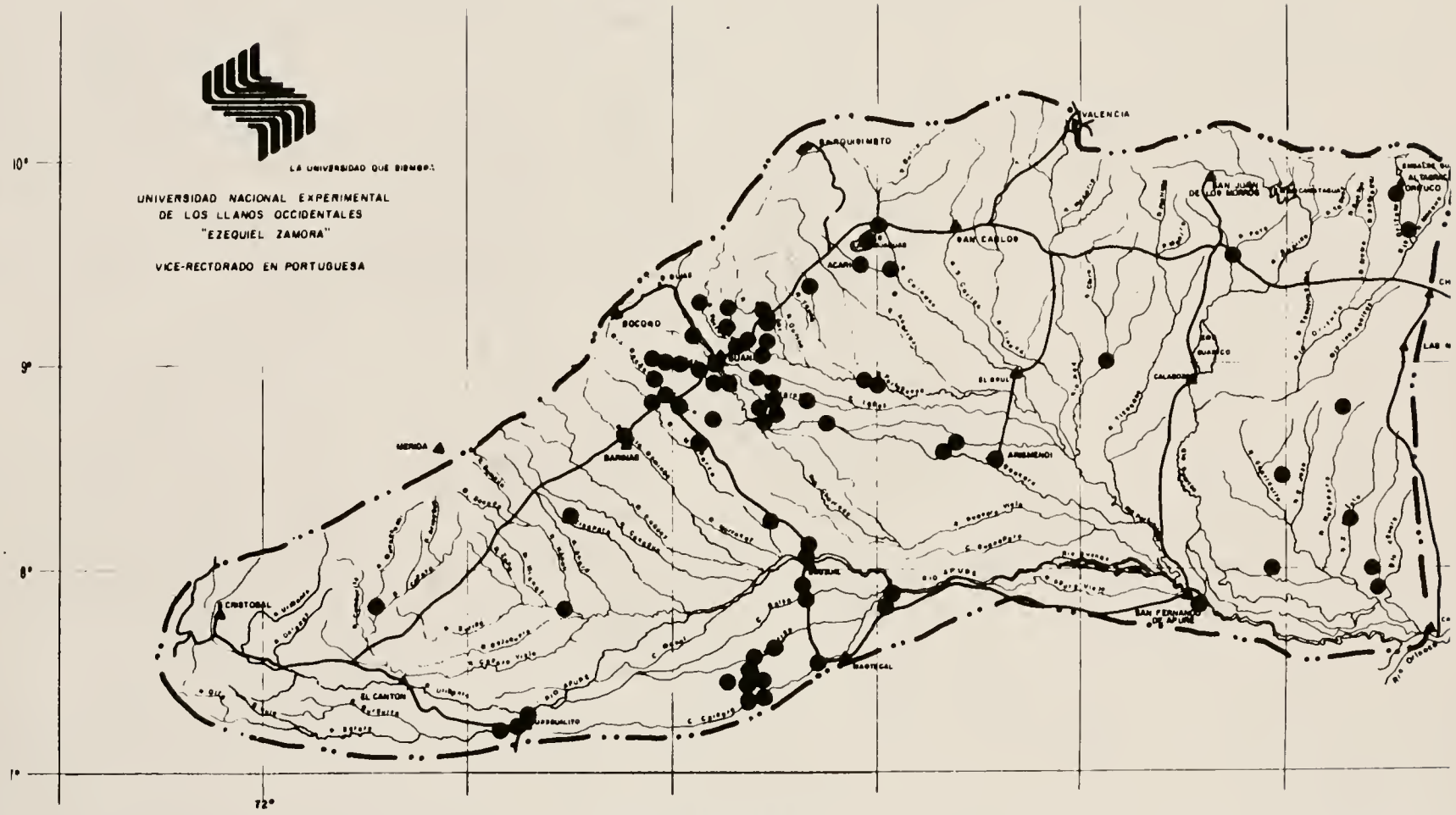
Reproduction. Strategy r2. There is no obvious anatomical sexual dimorphism in this species (Lilyestrom 1983), but females grow larger. It spawns annually at the beginning of the rainy season. The fish descend from the higher regions of the drainage to spawn in midriver

while moving downstream. Fecundity is very high, with 300,000--1,000,000 eggs per female. Males form schools in the center of the river and produce a grunting sound that can be heard on shore. Females pass into the spawning aggregate when ready to release their eggs. The eggs are semi-pelagic and apparently float out of the river into adjacent flooded areas where development proceeds rapidly (Bayley 1973). After hatching, the young usually proceed downstream or further out onto the floodplain. In the Apure drainage, the esteros and bajios provide food and cover for the growing young of the year. Evidence from the studies of Novoa et al. (1982) shows a high correlation between the degree of flooding and the success of the year class. Evidently, the more it floods, the more suitable habitat is available, and consequently more juveniles survive to enter the fishery. Efforts to drain wetlands or prevent their flooding will therefore directly reduce the number of coporo that enter the fishery each year.

Migrations. Spectacular annual upstream migrations of thousands of fishes occur at the beginning of the dry season. Fish travel upstream into the piedmont and mountains, seeking stable water levels, security from predators and a food source in the epibenthic algae that grow on hard substrates when reduced flows of the dry season increase light penetration. The coporos remain in the highlands, feeding until the rains return. During the first month of the rains, they descend, spawning along the way. The wet season is passed in aquatic meadows of the floodplains where they fatten for the next cycle.

Importance. This is the most important (by weight) commercial fish in the Apure Drainage, as well as in the Orinoco Delta (anonymous 1983).

Figure 306. Apure drainage distribution of *Prochilodus mariae*.


LA UNIVERSIDAD QUE DIRIMOS
UNIVERSIDAD NACIONAL EXPERIMENTAL
DE LOS LLANOS OCCIDENTALES
"EZEQUIEL ZAMORA"
VICE-RECTORADO EN PORTUGUESA
10°
9°
8°
7°
72°
VALENCIA
BARQUISIMETO
SAN CARLOS
ACARIGUA
BOCONO
GUANARE
BARINAS
MERIDA
ARISMENDI
CALABOZO
SAN FERNANDO DE APURE
MANTECAL
SAN CRISTOBAL
EL CANTON
RIO APURE
RIO ORINOCO
CUENCA DEL RIO APURE
ESCALA GRAFICA

Semaprochilodus kneri (Pellegrin) 1909

Bocachico

Fig. 307. Map: fig. 308. Couplet 1b.

Generic synonymy

Semaprochilodus Fowler 1941:171 (type species: Semaprochilodus squamilentus Fowler 1941 by original designation).

Specific synonymy

Prochilodus kneri Pellegrin 1909:155 (original description, type locality: Río Orinoco, Venezuela), seen; Schultz 1944b:265 (cited with reservations in synonymy of S. laticeps.

Semaprochilodus kneri Mago L. 1972:58 (redescription, key,); Géry 1977:215 (key); Novoa et al. 1982:277; Román 1985:130.

Etymology. SEMA = like, PROCHILODUS = the genus Prochilodus; KNERI = after Rudolf Kner, ichthyologist and naturalist.

Description

Illustrations. Fig. 307; Mago L. 1972:fig. 9; Cervigón in Novoa et al. 1982:fig. 13; Román 1985:130.

Diagnosis. See previous diagnosis to distinguish from P. mariae. This fish can be confused with the zapuara (also spelled sapuara), Semaprochilodus laticeps, but the latter does not occur in the Apure drainage, and usually has the opercular membrane edged in jet-black, the entire ventral fin red to orange, and has more bands (up to seven per lobe) in the caudal fin. It can also be distinguished by the relative position of the pelvic-fin insertion, which is well behind the dorsal-fin origin in S. kneri, but almost directly under the dorsal-fin origin in S. laticeps.

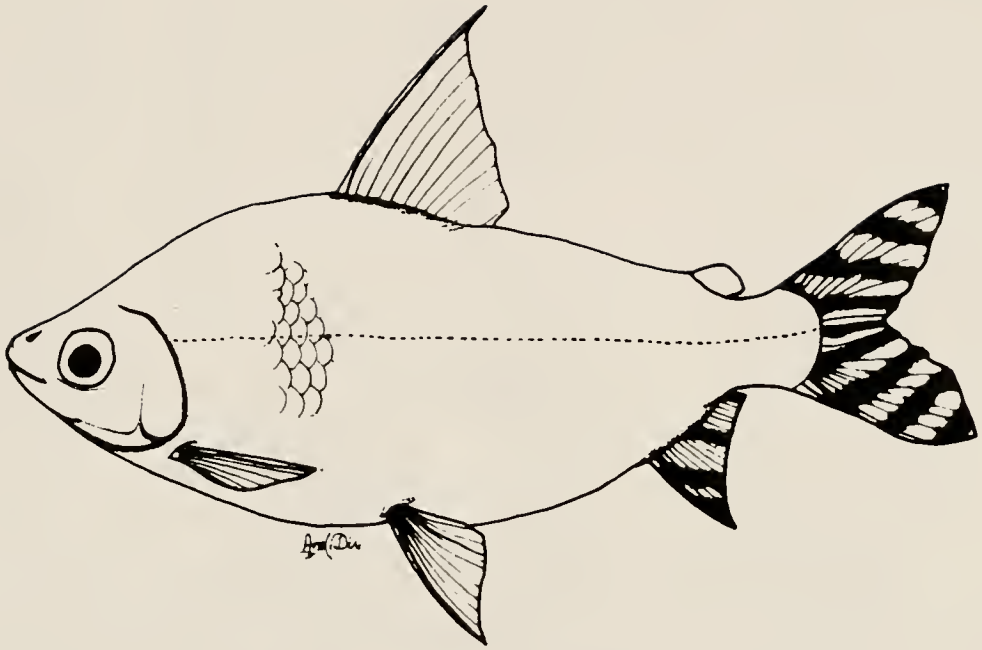


Figure 307. Semaprochilodus kneri.

Size. It can grow to about 350 mm SL. Novoa et al. (1982) reported a specimen that measured 315 mm total length and that weighed 0.5 kg, The largest specimen recorded in their commercial records was 433 mm TL. Most specimens are much smaller young of the year.

Morphology. The body is somewhat compressed. The dorsal profile is straight to slightly concave. The insertions of the pelvic fins are behind the dorsal-fin origin.

Counts. DR 11-13; AR 10-12; PR i13-i16; LLS 45-49; scales above lateral line 8-9; between anal and lateral line 6-7 1/2; between pelvics and lateral line 7-9; PDS 11-13; CPS 16-20.

Measurements. GBD 2.3-2.8 in SL. IO 2-2.5 in HL.

Pigmentation. The anal and caudal fin are boldly marked with alternating black and yellow bands (a central band and 3-4 more black bands on each lobe of caudal are present) but the dorsal and pectoral fins are transparent and the tips of the ventral fins may be orange, red or yellow. The body and the edge of the opercle are usually silver, and the opercular membrane is only weakly pigmented, not jet-black as in *S. laticeps*. Small or poorly preserved specimens may appear plain silvery, without any characteristic markings.

Distribution and Natural History

Range. It is known from the Orinoco Basin.

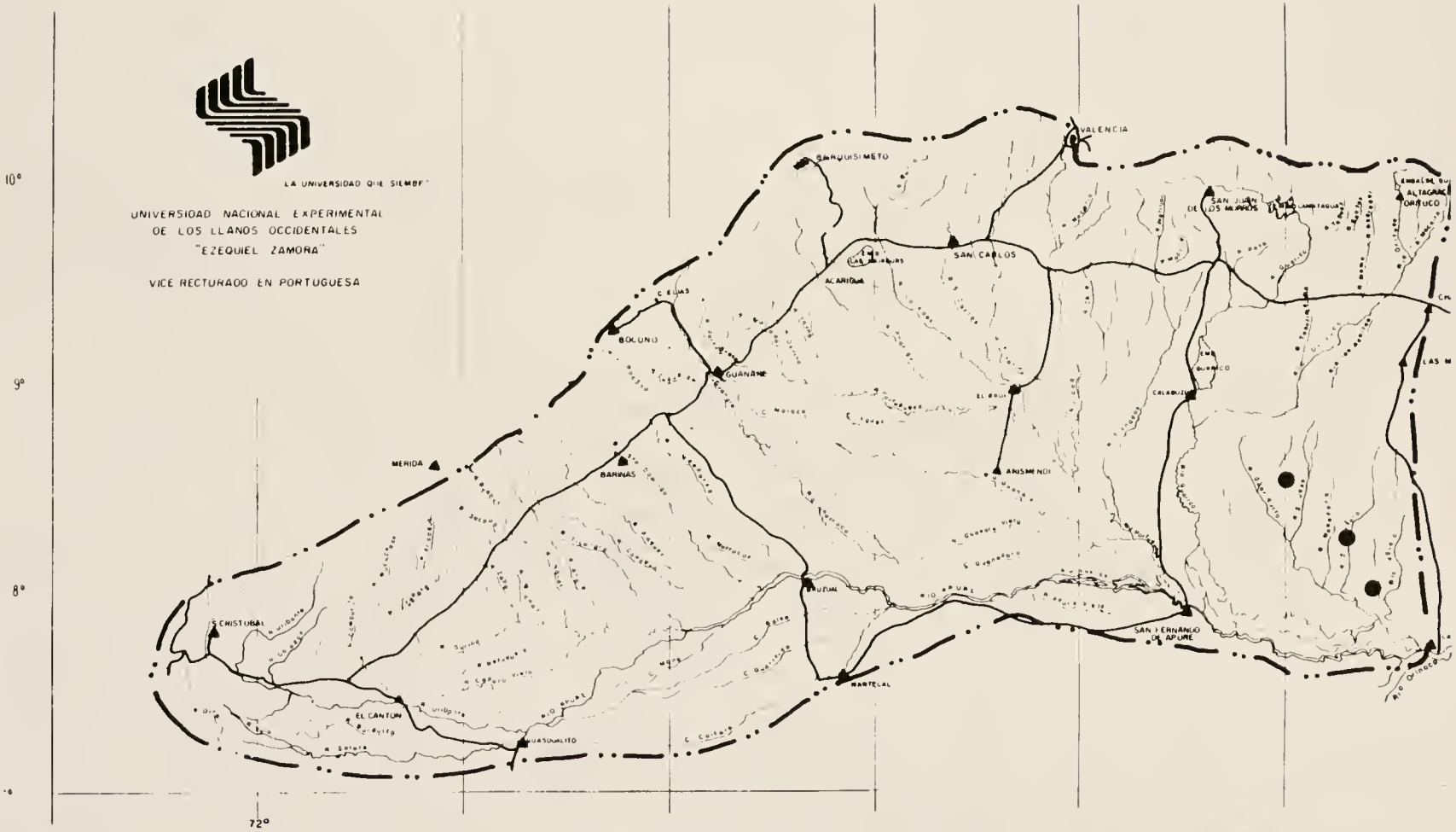
Apure distribution. Map: fig. 308. It is known from the Aguaro River system of the southeastern Apure drainage.

Habitat. It occurs in clear and blackwater streams of sandy-soiled savannas. Abundant aquatic vegetation is usually present.

Abundance. RARE. It is more common in the lower Orinoco.

Number of specimens examined. 6 from 4 sites.

Figure 308. Apure drainage distribution of *Semaprochilodus kneri*.



CUENCA DEL RIO APURE

Food. ILIOPHAGE. Its diet probably includes bacteria and protozoans found in mud and detritus, and epibenthic algae.

Reproduction. Probably r2. It is an annually spawning species that initiates reproduction with the first rains. Fecundity is very high, as in most members of the family.

Migrations. In the Orinoco delta this species migrates along with the zapuara from July to September (Novoa et al. 1982). The Apure drainage populations have not been studied. I suspect that it moves in and out of the flooded savannas of Guárico state seasonally, and then descends the Orinoco to join with other populations further downstream.

Importance. Ornamental. It is sometimes sold as a commercial species, but because of low abundance it is not particularly important in the Apure drainage.

DISCUSSION

Ecological Considerations

The bulk of the autecological information gleaned from the field data sheets is presented in the individual species accounts. Here I make some generalizations about characiform's adaptations to the llaneran environment and to each other.

Physical parameters of the Apure River drainage

The Apure River, which drains 167,000 km^2 and delivers an annual average of 2,000 m^3/s of water to the Orinoco, is one of Venezuela's largest. Its drainage is geographically widespread and includes all the territory in the Venezuelan states of Portuguesa, Cojedes and Barinas, a large portion of Apure and Guárico, and parts of Táchira, Mérida, Trujillo, Lara, Yaracuy, Carabobo and Aragua. This vast region includes a wide range of aquatic habitats, and characiforms are found in most of them. Most of the Apure's tributaries are born in the Andes, where the highest areas (between about 3500 and 5007 m), called páramos, consist of cold, rocky meadows of plants specialized for life above the treeline. The highest páramo streams are cold, usually around 5^oC and are usually devoid of native fishes, although trout have been introduced into some, and astroblepid and trichomycterid catfishes can occur at these altitudes. Below this cold zone most of the mountains are (or were originally) forested. Andean gradients are steep, and the rivers that drain them descend with a tumultuous roar during the wet season.

Few characiforms have been able to adapt to the low temperatures, rapid currents and continuous scouring action of the substrate, but there are notable exceptions. The saltador, Salminus hilarii, is a salmon-like piscivore that inhabits this region, the palambra, Brycon whitei, is another montane species that reaches a large size (up to 4.0 kg). Both are considered excellent sport fishes, but habitat destruction has made them scarce. There are also a few smaller characids that have adapted to life in the mountains, such as Hemibrycon metae, Astyanax metae, and Creagrutus cf beni. Although the characidiids are typically found in riffles, only two species are found exclusively in the higher montane regions, Characidium chupa and C. voladorita. The piedmont (roughly the area between 100-500 m) is a fairly narrow transitional area between the mountains and the plains. Heavily eroded hills and terraces characterize this region, rivers slow their pace slightly as they pass through, and in general aquatic habitats are more hospitable and harbor a wider variety of fishes. Besides the full-time inhabitants, the mountains offer refuge to many species during the dry season, when water velocities slow, the rivers drop in level and decant much of their sediment load. The most important of the part-time occupants is the coporo, Prochilodus mariae, but many other fishes also ascend. The morocoto, Piaractus brachypomus, tusos Schizodon isognathus, several species of mije, Leporinus spp, all take advantage of the dry season refuge found in the Andes.

By all accounts, the llanos dominate the drainage. They are often divided into high and low llanos, but this distinction is somewhat subjective. High llanos are usually defined as those areas adjacent to the piedmont, between about 70-100 m above sea level. They are better drained, more suitable for pastures and crops, and less susceptible to long-term

flooding than the low llanos (between about 45-70 m). It is in the llanos that fish diversity and biomass reach their peaks (Mago L. 1978, Taphorn & Lilyestrom 1984, Machado A. 1987).

The llanos are extensive, exceedingly flat alluvial plains (where a gradient of only two to three centimeters per kilometer isn't unusual). Although Portuguesa and small parts of other states have soils well-suited for agricultural crops, much of the Apure drainage is covered with poor gravel-laden soils, and reddish, heavy clays interspersed with areas of white sands (the latter most notably present in northern Apure state, central and western Barinas state near Ticoporo and El Nula, and the Aguaro system in Guárico state). When undisturbed, the soils supported a natural terrestrial vegetation of open, dry tropical deciduous forest in the "high" llanos and grassland savannas on the poorer, fully leached, sandier soils. But cattle ranching, the most extensive land use in the Apure drainage, and agriculture have caused widespread deforestation and annual burning. Portuguesa state, which was over 90% forest before man arrived, is only about 10% forested today.

Some climatic statistics would seem to indicate environmental stability for the llanos, but this is an illusion. For example, the average annual air temperature never varies much from between 26-27° C. Daily air temperatures vary much more widely. Water temperatures vary from lows around 23-24° in the shady forested streams near the mountains to over 37° C. in open, shallow, flooded savannas. In reality, however, this region suffers climatological extremes of astonishing proportions. Characiforms, as well as most other Apure drainage fishes, are inextricably linked to the annual rainfall pulse that reverberates throughout the aquatic and terrestrial communities. Water regulates and controls

their life cycles. It sets the time of their birth, and for most, the time of their death. This annual heartbeat drives the evolutionary forces, and casts the dice for the lottery of natural, catastrophic selection that has shaped this remarkable assemblage of plants and animals into wonderfully complex communities that we are just beginning to understand.

Although annual rainfall in the llanos is, on the average, high by North American standards, 1200 mm (47 in) to 1800 mm (71 in) per year, the effect of these rains is even more pronounced since they are concentrated in the seven or eight month wet-season from April to November. Rainfall in some mountain areas is even higher (over three meters). Rivers like the Caparo, Santo Domingo, Boconó, Guanare and Portuguesa annually swell with sediment-laden torrents that overflow their banks and flood the surrounding lowlands. In contrast, the deserts near Barquisimeto, receive infrequent downpours that provide only 400 mm (16 in) of rain per year. Average runoff from the Apure River drainage during a 21 month study period was measured at 361 mm/year by Saunders & Lewis (1988a). The wide range in gradient (over 5000 m to about 43 meters above sea-level) creates an equally wide range in substrate type. Boulders and cobbles pave Andean streams. These gradually shift to finer gravel, sand, mud and silt as rivers leave the mountains and drop their sediment loads on the plains. The heavy load of sediments, and abrupt shift from very high to very low gradient causes a peculiar topography to develop in the high llanos. The rivers flow perched atop levees of their own making. As the waters descend from the Andes and enter the llanos, they lose velocity and carrying capacity and drop much of their sediment load. Through the ages these deposits form natural levees. The elevated

river bed thus formed is not very high, but since the natural slope is so gentle, once they top their banks, river waters must flow many kilometers over the plains before they can return to a channel. This phenomenon occurred a few years ago in the town of Arismendi, which, when the Guanare River flowed through it, was a fishing village. But the Guanare jumped its banks during a high flood, cut a new course south of town, and left the fishermen's dugout canoes in Arismendi high and dry. Engineers tried in vain to coax the roving river back into its old channel without much success. Because the rivers wander about so, most of the llanos form part of the floodplain at one time or another, and many abandoned meanders remain as lakes or esteros (Ramia & Morales 1978) sometimes interconnected by seasonal anastomosing waterways that fill with rain or floodwaters each year in the rainy season. When the Apure River nears the Orinoco in the area to the southeast of San Fernando de Apure, it forms an internal delta of some 5000 km^2 (Saunders & Lewis 1988a) because of the damming effect exerted by the waters of the Orinoco. During the peak rainy season from June to September the entire area floods and forms a vast inland sea of slowly moving fresh water.

A visitor to this area who arrives for the first time in March would scarcely believe that the llanos flood so extensively, for the dry season is truly devastating, especially to the fish fauna. As we will see, this annual climatic catastrophe plays a key role in determining fish community structure and the life history strategies of llaneran fishes. From December through March, almost no rain falls. The inland sea evaporates away, grasslands parch and then burn, the earth cracks under the searing heat, and violent winds lift ashes and dust into a hazy sky. Sunsets usher darkness in with earthy red hues caused by suspended

particulate matter. Stranded fish die by the millions, providing a rich bonanza to the terrestrial communities and especially to the wading birds. Water is limited to main river channels, a few of the larger creeks, lagoons and man-made reservoirs and ponds. Life concentrates round these oases. A very narrow bottle-neck relentlessly culls fish populations to a tiny fraction of their numbers and biomass at peak flood. Thus, the extreme variability of climate, altitudinal gradient, and the tendency of most llaneran rivers to go "a-roving," has created a rich mosaic of aquatic habitats that has undoubtedly contributed to the rich species diversity encountered here.

To better appreciate these conditions and their effects on fish communities, one could imagine that the llanos as a part-time desert and a part-time marsh. It is both of these extremes and passes through all of the intermediate states each year. Classic limnological separations between lentic (standing) and lotic (moving) aquatic habitats are difficult to apply here because microhabitats are continually shifting. As a result, as Roberts (1972) noted, faunal composition changes continually. In a sampling program carried out in Caño Maporal (Matheus 1984), we fished monthly at precisely the same site, for over a year in a tributary to the blackwater Caño Caicara in northern Apure state. Seldom did the monthly samples exceed forty species, and yet total number of species at the end of the project approached 120. As conditions shifted with the advancing seasons, different species occupied the area. Thus, with a constant state of flux in environmental parameters and fish assemblages, meaningful aquatic habitat classification, so necessary for environmental planning and effective fisheries management proves frustratingly elusive. But progress is being made.

Limnological investigations in the Amazon basin, pioneered by H. Sioli (1984), have shown that there are three fundamentally different types of water in the neotropics: black, clear and white. At first this classification was somewhat arbitrary and subjective, based mostly on apparent color. Blackwater streams, (better described as brown, tea-colored, or even reddish), are stained with organic acids leached from decaying vegetation, have almost no nutrients or other dissolved solids, very low pH, and low productivity. Whitewaters (so called because they are muddy and appear whitish from a distance) carry heavy sediment loads, are usually neutral to slightly acidic or alkaline, have low visibility, but are relatively productive. The clearwater category is probably the least satisfactory of the three for it can include variable stream types such as whitewaters that have dropped their sediments, very slightly stained blackwaters, as well as true clear water (for example, spring flows). While the classification does tend to oversimplify reality, it has been a useful model to promote investigation of tropical limnology. In the Apure drainage, the soils and waters are seldom as poor in nutrients as those described for most of the Amazon Basin (Fittkau et al. 1975). Even though the pH of the water, hardness and nutrient content vary with the origin, soils and vegetation of the stream system, most can be classed into one of the three general types described above. Whitewater streams originate in the Andes, are usually muddy, have a slightly acidic to slightly alkaline pH, and are relatively high in nutrients. Blackwater streams originate in the flat, sandy parts of the lowlands such as the Guaritico system in northern Apure state, are usually stained reddish-brown, have very low turbidity, are acidic (pH 5-6) but not as extreme as Amazonian waters, and have low amounts of

dissolved minerals. Permanent clearwater streams are not common in the Apure drainage, but a few exist where springflows originate, and temporarily clear streams form in the dry season when mountain streams from forested areas decant most of their sediment load due to decreased flow. In an area where extensive flooding is the rule, these three basic types can be expected to mix, and they do so extensively. Some streams in the lower portions may seasonally change from one water type to the other as water sources vary. As a result, many llaneran fishes have adapted to exploit a wide range of constantly shifting conditions in the numerous microhabitats available.

More precise data have refined our understanding of tropical rivers. Since the Apure River has a relatively high sediment load (median, 233 mg/l) and a conductance between 88 and 225 uS/cm (Saunders & Lewis 1988b), it is classified as a whitewater river. Those same authors characterized some features of the Apure River's water chemistry and found discharge weighted mean concentrations for total phosphorus of 188 ug/l, 957 ug/l for total nitrogen, and 9.8 mg/l for organic carbon. Annual transport was 0.68 $kg.ha^{-1}$ for total P, 3.45 $kg.ha^{-1}$ for total N, and 35.4 $kg.ha^{-1}$ for organic C. Particulate matter accounted for 68% of P, 54% of N, and 37% of C transport. The molar C:N:P ratio for the Apure is 135:11:1; for the Caura (which has a much higher average runoff of 2423 mm) it is 772:47:1. Dissolved phosphorus, nitrogen and organic carbon, were all found to rise with increasing discharge in the Apure, but fell during the prolonged inundation phase. As the water receded, concentrations of particulate fractions and some dissolved inorganic fractions rose again. The pattern in the Caura was different, in part due to the very different configurations of the drainages. The Caura

drains the rocky Guyana Shield, is mostly confined to its main channel and has a very narrow floodplain. The Apure drains the geologically young Andes, and is in contact via flooding with a very wide extensive floodplain for most of the year. These physical variations in nutrient and light availability lead to corresponding biotic variations.

Productivity of the Apure River.

Lewis (1988) measured the annual mean gross primary productivity (as carbon) of the Caroní, Caura and Apure rivers in Venezuela. The whitewater Apure registered the highest value, 26 $mg.m^{-2}.d^{-1}$, the Caura 13 $mg.m^{-2}.d^{-1}$, and the Caroní only 4 $mg.m^{-2}.d^{-1}$. The main channel of the Orinoco River varied from 19-43 $mg.m^{-2}.d^{-1}$. This was true in spite of the suppression of potential production by dissolved and suspended substances, which was calculated as 85% for the Apure, but only 40% for the Caura and Caroní. Autotroph biomass (phytoplankton) values were also highest in the whitewater Apure river. Zooplankton abundance and transport were studied by Saunders and Lewis (1988b) in the Apure River for a fifteen month period. They found more than 50 species of zooplankton, but nine rotifer species accounted for more than 90% of the total density (mean, 138 individuals/l). Crustaceans comprised 46% of the annual mean zooplankton biomass (1.9 ug $C.l^{-1}$), but only 2% of zooplankton numbers. Zooplankton abundance showed a marked, inverse relationship to the river' s water discharge rate. These values are much higher than those reported for other neotropical rivers. For example, Vásquez (1984) found maximum densities of rotifers of only $5.2.L^{-1}$ in the blackwater Caroní, and Saunders & Lewis (1987) found up to $36.L^{-1}$ in the Caura.

Characiform adaptations to their environment.

Fishes in the Apure drainage have responded to the fluctuating seasonal extremes of drought and flood in many different ways. Species that live most of their lives in large river channels (eg. the cynodontids), and those limited to high mountain streams in forested areas (eg. small tetras like *Corynopoma riisei*), experience less environmental fluctuation and have adopted appropriate life history strategies (Winemiller & Taphorn 1989).

Perhaps the most spectacular behavioral adaptation to the seasonal wetlands is the "ribazón," or upstream migration of the coporo, *Prochilodus mariae* (see species account for details), with its associates such as the palometa, *Mylossoma duriventris*, the mije, *Leporinus friderici*, and the palambra, *Brycon whitei*.

Some species have "chosen" to physiologically adapt to the harsh dry season conditions instead of migrating away from them. During the drought, the water in the remaining pools is often fouled by decaying vegetation, rotting fish carcasses of less tolerant species, and feces from the hundreds of piscivorous birds that gather to reap the harvest that waits, gasping for breath, near the surface in the shallows. Most fishes try to avoid being trapped under such circumstances and move locally (the lateral migrations of Welcomme (1979)) from drying savannas into streams and rivers. Those caught tardy will often go to considerable lengths to escape. The guabina, *Hoplias malabaricus*, is known to travel overland in search of better pools when conditions get tough. Air breathing, allows the agua-dulce, *Hoplerythrinus unitaeniatus*, to tolerate conditions that are lethal to most fishes. But even these adaptations are not foolproof, the environment is just too unpredictable.

The above are just a few of the classic, frequently cited (Lowe-McConnell 1975, Welcomme 1979, Machado A. 1987, Taphorn 1988) examples of adaptations that fishes have made to survive on tropical floodplains and savannas. But they are the special cases, and account for very few of the 137 characiforms that are found in the Apure drainage. What are the rest doing? Simply stated, they play the numbers game. That is, they reproduce by the millions, filling every available nook, niche and cranny with fish during their heyday in the rainy season. They pay the price when the floodplain dries up again and most of the individuals (probably more than 99%) die. Roberts (1972) suggested that chance plays a major role in the local distribution of fishes in the tropics. Chance is also important in the determination of which individuals will make it through the bottle-neck to survive. The characiforms literally place eggs in as many baskets as possible and "hope" that somewhere among all the millions that are born each spring, somebody will make it. Of course, many species hedge their bets with physiological and behavioral adaptations to adverse conditions, to get a slight edge just in case they make it through the first crunch. But even so, it is still mostly up to chance to determine which specific individuals will make it. Different local conditions make year to year "predictions" of safe dry-season harbors nearly impossible, especially for the individual fish. But the species survive and indeed flourish because they have individuals everywhere possible, and play the odds. As we will see, there are different life history strategy options available to fill as many nooks and crannies as possible with offspring.

The different life history strategies adopted by characiforms, represent compromises between the opposing ecological pressures (for

example high juvenile survival vs high fecundity) that pull a species in different directions. Winemiller & Taphorn (1989) grouped the different types of compromises into three basic categories, r1, r2 and K strategies. Each strategy can be considered the endpoint or extreme of one branch of a three dimensional continuum of responses, with each species' "best answer" being potentially different from all others. This classification is used here to denote the three tendencies among the greatly varying reproductive strategies observed in Apure drainage fishes that we have recognized.

The first tactic, termed the K-strategy, is characterized by a relatively high juvenile and adult survivorship, a relatively long generation time and long life. Fecundity in species that have adopted this strategy is low per reproductive bout, but reproduction may be repeated (iteroparity) as long as conditions remain adequate and food is available. Some of these species even continue to spawn during the dry season. On the average, these species suffer much smaller population density fluctuations between the wet and dry seasons. K-strategists tend to be medium to large-sized fishes. There are only a few species that have adopted this tactic in the Apure drainage, and none of them are characiforms. Although the red-bellied piranha, Pygocentrus caribe, probably builds nests and guards its eggs, it has a relatively high fecundity, and spawns but once per year as do most r2 type fishes.

I have likened the characiform's strategy for survival to a lottery, but there is a twist. It is more like buying all of the tickets in a lottery to be sure you win (ie, you get a few winners, but millions of losers). Since the prize (goal) here is species survival, not money, this strategy is very successful. All the Apure drainage characiforms

play it to some extent. The second, or r1-strategy, is applied to those species with low juvenile and adult survivorship, low fecundity per reproductive bout, but many bouts per season, a short generation time, and population densities that fluctuate greatly between the wet and dry seasons. About half of the Apure drainage characiforms have adopted this strategy as the best option to an unpredictable (in the short term), fluctuating environment with a catastrophic reduction in habitat and food availability in the dry season (and the resulting annual "crash" in their populations). The common tetras (called "sardinas" in Venezuela) such as Astyanax, Moenkhausia, Hemigrammus etc. are all r1 strategists. They make up for their lack of longevity, size, and protection of their young with high numbers of small individuals that reproduce repeatedly for as long as conditions are favorable.

The third tactic, the r2-strategy, is characterized by very high fecundity in an annual (one-time) spawning bout usually undertaken in schools or groups of fishes instead of individual pairs, low juvenile survivorship, but high adult survivorship and longevity, and large fluctuations in population density between the wet and dry season. A typical example of this type of response is the coporo, Prochilodus mariae, the most important species of the commercial fishery. The coporo spawns in large schools in the center of the river at the beginning of the rainy season. Each female releases hundreds of thousands of semi-buoyant eggs which are fertilized "en masse" by large numbers of attendant males. The eggs are abandoned to drift out into the fertile waters of the floodplain.

There are many concomitant adaptations to this approach to survival of the lucky. Many fishes are particularly tolerant to low oxygen

levels, even if they can't breathe air. Winemiller (1989) has shown that many characiforms grow protuberances on their lips to allow them to breathe the better oxygenated surface layer of water. Most species can tolerate high temperatures that would quickly prove fatal to most temperate fishes. Many species fast for the dry season months. This is true not only of the large predators that lay down heavy fat deposits by consuming lottery losers, but also of smaller fishes. These adaptations assure that the sweepstakes winners will be able to make it through the adverse conditions that prevail.

Ichthyologists tend to focus their attention on the dry season adaptations because it is at this time that natural selection and chance act most devastatingly on the fish populations. At first examination, the massive mortalities seem to bear grim tribute to the now somewhat dated "survival of the fittest" theme. Indeed the widespread deaths at this time calls to mind an evolutionary day of reckoning. But these are catastrophic deaths, and although they are predictable from year to year on an evolutionary time scale, at the individual level (the only level where selection can act so far as anyone has been able to show), chance plays more of a role in determining "who" makes it. We carefully study and document the extreme adaptations that allow a few unusual species or individuals to make it through the dry season, and while these are extremely interesting, and many quite ingenious and amazing, these examples tend to make us overlook the simple fact that most fish, even those with the elaborate adaptations, simply die. They rely on the gonad power of the lucky to replenish their numbers, and thus insure the survival of the species, for one more year.

In Table 3 we can see that characiform species are about evenly split between the r1 and r2 strategies, and that none are K-strategists. Since characiforms occupy all available habitats from mountain to llanos, lentic and lotic, forest, savanna etc., and take advantage of all the varied food resources available with a wide array of morphological, physiological and behavioral adaptations, we might ask "Why are there no large characiforms that take care of their young?", "Why are there no characiform K-strategists?". If fishes could speak they might respond "It's simply not done!". In other words, phylogenetic constraints seem to be involved. Apparently Apure drainage characiforms simply do not have the K-strategy program included in their genetic material. We can observe the other extreme in the family Cichlidae, almost all of which, large or small, are K-strategists. Breaking out of these phylogenetic constraints would seem to be much more difficult (none of the 138 species of Characiforms in the Apure drainage have done so) than switching habitats (eg. Prochilodus mariae and its migrations) switching diets (eg. juvenile Pygocentrus caribe eat plankton, then switch to aquatic insects and later small fishes) or even changing their physical morphology (eg. species that temporarily develop lip protuberances to breath the oxygen-rich water at the surface). Another reason that r-strategists dominate in the Apure drainage has to do with the strongly seasonal nature of the llanos and the annual catastrophic population crash it causes. Pianka (1974) pointed out that K-strategists should be favored in "saturated" environments, those with all the niches filled with species. The annual fluctuation in most llaneran aquatic habitats probably prevents fish communities from ever reaching equilibrium. Thus, a "poly-unsaturated" environment is recreated each year when the rains return. R-strategists

are favored in such conditions. As Pianka (1974) also pointed out, a low expectation of finding prey, or a high mean search time per item, demands generalization. The constantly shifting physical parameters typical of most Apure drainage aquatic habitats probably make it difficult for fish to concentrate on a given prey species, whose numbers are fluctuating in conjunction with the physical parameters (Saunders & Lewis 1988b), for the amount of time required to develop specializations. Hence, most Apure drainage fishes are omnivores and feeding opportunists.

Table 3. Number of Apure drainage characiform species (tallied by family) that exhibit life history strategies K, r1 and r2.

	K	r1	r2	Total
Anostomidae	-	4	8	12
Characidae	-	50	39	89
Characidiidae	-	11	-	11
Chilodontidae	-	1	-	1
Ctenoluciidae	-	-	1	1
Curimatidae	-	-	8	8
Cynodontidae	-	-	3	3
Erythrinidae	-	-	3	3
Gasteropelecidae	-	-	1	1
Hemiodontidae	-	-	2	2
Lebiasinidae	-	2	1	3
Parodontidae	-	-	2	2
Prochilodontidae	-	-	2	2
TOTALS	0	68	70	138

Characiforms are the most speciose and usually comprise the greatest biomass of all Apure drainage fishes in many biotopes. Why is this

incredible diversity so great, and how do they sustain such high biomass? Many authors have addressed the question of high diversity in tropical fish communities (Roberts 1972, Pianka 1974, Lowe-McConnell 1975, Welcomme 1979, Machado Allison 1987). Pianka (1974) provided one of the best summaries of the various theories in his list of 10 hypothetical mechanisms of diversity:

1. Evolutionary time. The ancient age of the tropical regions in terms of evolutionary time allows species to evolve. For example, the glaciers in North American periodically decimate fishes, the survivors have not yet reached maximum diversity. This does not happen in the lowland tropics, and so more time has been available for evolution to create new species.

2. Ecological time. This hypothesis supposes that the highest tropical diversity should occur where fishes have had the longest time to disperse. Newly created areas (in a geological time-frame) would have fewer species because of the time necessary for species to disperse across ecological barriers.

3. Climatic Stability. Stable climate leads to higher diversity. This idea is being questioned more and more, as more data is available, and a more precise definition of stability is adopted. Under certain circumstances this may be true, but in others the very opposite may be true.

4. Climate predictability. If climate variation is cyclic, it can be predicted, adapted to and species diversity proceeds.

5. Spatial Heterogeneity. High diversity of niches available to tropical species allows more speciation. This argument never has been convincing to me since habitat diversity would seem to be just as rich

is many temperate zones where species diversity is much lower than in the tropics. It is of use to explain local variation in species diversity, but has little application at the macro-evolutionary level.

6. High productivity, due to more sunlight and warmer temperatures all year round, accelerates evolution, by allowing the development of feeding specialists (and eventually, new species). That is, if there is more food available, you can afford to be "picky."

7. Stability of Primary Production. Plants can buffer climate and make food available on a more stable basis (or do the opposite). This hypothesis would suggest that plants make food resources more "convenient" for year-round consumption in the tropics than in temperate zones (where winter requires a dormant stage). However, the tropical dry season would seem to be just as much a problem to tropical plants, and perhaps even more so. High dry season temperatures without water are probably more stressful than the low temperatures of winter (when temperate plants are mostly dormant). Perhaps this explanation is apt for tropical rain forest regions without a dry season.

8. Competition. This hypothesis holds that natural selection for competitive ability (K-strategists) is keenest where communities are diverse. Again, this is assuming a species saturated community. As we have seen, the Apure drainage is dominated by r-strategists, and in this respect is more akin to temperate communities that are more governed by abiotic factors than by biotic interactions.

9. Rarefaction. This hypothesis refers to the continual, density independent removal of organisms from a community. It suggests that where communities are not fully saturated with species (such as in the Apure drainage where climate catastrophically removes most of the fish

population each year) more species can coexist. That is, such communities are in a sense oversaturated with species, but since losses are due to chance, it doesn't really matter.

10. Predation. This argument is similar to 9, in assuming that predation, whether selective or random, will always rarefy prey species and keep them from competing severely with each other. Thus, predators can suspend the competitive exclusion principal for prey species, by thinning their populations. Since predation is usually preferential, it is usually frequency dependent, and would further promote prey diversity. That is, if predators eat the most common prey item available at any given time, no one prey species can bloom at another's expense, and more can coexist.

In addition to a combination of several of the factors mentioned in the above hypotheses, the fish communities of the llanos experience something akin to the "founder effect" of island biogeographers, but it happens not just once but every year. These fishes reclaim 99% of their habitat each and every year. The evolutionary implications of this simple fact are far-reaching. It is as if each year, a small group of founders arrive to repopulate (in only 8 months for most characiforms) a recently made "island" (in this case a freshwater sea) virtually unoccupied by other creatures. We can envision pools (gene and otherwise) of survivors during the dry season in the mountain springs, in deep river channels, and in crocodile holes (before they were exterminated by skin hunters) etc., that shelter a tiny percentage of the total annual biomass. This seed stock germinates with the first rains, and the recolonization begins. This yearly reshuffling of the evolutionary deck of genes has undoubtedly further contributed to the high diversity by

reducing the generation time to one year, thus accelerating the evolutionary clock in a manner reminiscent of the insects.

Although llaneran fishes most likely have an "evolutionary memory" of the dry season and its consequences, the catastrophic nature of the mortality suffered means that no individual, no matter what its specializations to survive might be, is certain of survival or even reasonably positive about it. Thus, generalists are favored, and opportunists rewarded. Analysis of Table 4 shows that this is precisely the case. Most species, even those with fairly complex morphological feeding adaptations, are quite ready to switch to the most abundant food item available at any given time. Omnivores abound. Of the 137 species of characiforms studied, 81 were classified as omnivores, 40 as carnivores, 10 as detritivores, and six as herbivores. The high biomass observed in the Apure drainage (Taphorn & Lilyestrom 1984) is probably partly also a consequence of the seasonal nature of the environment, and the mandatory recycling of energy that ensues. Fishes may never exhaust the diverse food sources that become available as the season advances and the aquatic habitat continues to expand. Very few food studies of tropical fishes have taken prey availability into account. This is so because prey items (usually invertebrates) are hard to identify, and difficult to sample quantitatively. One study that did take prey availability into account (Angermeier & Karr 1983) came to the conclusion the distribution (highest biomass concentration) of several fish species, belonging to various feeding guilds, were not generally correlated with availabilities of their major food resources. Their study, however, was carried out in the dry season, and most species were probably more concerned with simple survival than optimum food resource utilization. They found that most

species were concentrated into deep pools in the Panamanian streams studied. As more data are available, I believe a pattern will emerge to show that most fishes in the Apure River drainage are not limited by food resources. Amazonian blackwater habitats, where the water is nearly sterile and without dissolved ions of any kind, and pH values drop to below 4.3, probably provide so little food as to severely restrict fish populations.

Perhaps because I study them, tropical fishes seem "smarter" than most temperate fishes. They seem to be more aware of their surroundings and harder to catch. One behavioral difference I have noticed is the tremendous drive these fishes have to "get up and go," once it starts to rain. There seems to be a very strong instinctual urge to move out, and to do so with haste, and not just in the migratory species but in most fishes in general. Spurred by rising rivers, most fishes leave their dry season sanctuaries and move upstream into creeks, and out onto the flooding savannas. In a short time, every little ditch, pool or pond that connects into the growing fluvial system as the rains pour down, is teeming with fishes. They move out to find feeding grounds, to avoid predators amidst the dense cover provided by the grasses on the flooded plains, and to spawn. Rapid reproduction is favored in this system. Fishes are "anxious" to spawn, and many have gonads that ripen (no doubt at great physiological cost since these fishes are the survivors of the drought) just before the rains fall. The coporo is such a species. By spawning in mid-river they suspend their offspring in low-visibility waters, counting on the rising tide of flood waters to carry them out onto the plankton-rich floodplains. Dispersal is rapid and widespread. Many small tetras share the drive to move out and spawn as soon as it

rains, which is understandable in light of the different strategies outlined above.

Most characiform fishes present in the Apure drainage are characterized by relatively rapid growth. The luxurious aquatic pastures that form on the flooded savannas are very shortlived and must be quickly exploited. The ability to attain adult size and reproductive maturity quickly, and to lay down abundant fat reserves are crucial since these qualities may determine which of the lucky survivors will make it all the way through the dry season to successfully spawn. Survival itself is not sufficient, since individuals must survive in good enough condition to reproduce almost immediately, before major food resources again become available after the first rains. Under these conditions, small species are probably favored (most characiforms are under 60 mm at maturity). Because predators abound, rapid growth is a must. The faster you can get bigger, the better. It is a hurry-up, boom and crash population curve.

As we learn more about llaneran fishes, it seems that the rich species diversity is maintained in part at least by the constant state of flux in the environment, or in other words by instability.

In a year-long study of the fish communities of the modules of Apure (the modules are large, 20 x 12 km^2 sections of sparsely wooded savannas that have been surrounded by earthen dikes about two meters high, they maintain a huge shallow lake that gradually dries up during the dry season, and provides the moisture necessary for cattle and pastures, see Taphorn & Lilyestrom 1984 for a more complete account), we observed that greater stability and isolation from the fluctuating floodwaters led to lower species diversity. In the creeks and recently formed modules about 120 species of fishes were found, whereas the

older, more stable modules, with large areas that remained permanently flooded from year to year, were found to have only about 40 species, or only one-third the number of the younger modules.

Kushlan (1976, 1980) found an opposite effect (greater stability promoting greater species diversity) in the Florida Everglades, indicating some very fundamental differences between the subtropical and tropical communities. In Florida, during the unusual stable period, large predators were able to dominate the community that would otherwise normally consist of small omnivores.

In the Apure modules, large predators "dominated" in both biomass totals as well as the actual number of species present, but the large predators were the among the best adapted to fluctuations in the climate, and hence the most likely to survive the dry season. I put the word "dominated" in quotes because one must bear in mind that the image drawn of a fish community by sampling with seines a few times during the year only gives us a snapshot of the community structure at the time the sample was taken, and this from microhabitat sampled. On the floodplain, most dry season pools are full of large voracious predators and a few tetras. The trophic webs begin in the spring on the flooded savanna when millions of tiny fishes are present, most of them either herbivorous (feeding on epibenthic or epiphytic [on submerged terrestrial grasses] diatoms and algae) or omnivorous (feeding on both algae and microcrustaceans). These millions of tiny fishes are the real base of the trophic pyramid. Most of them perish in the first few hours or days of their lives, and heavy predation continues throughout the year. Thus, the relative percentage of the carnivores vs the herbivores (or the more common omnivores) will continually fluctuate as the season advances.

Table 4. Classification of Apure drainage Characiforms by:
Life History Strategy (K, r1, r2);
Diet (C = Carnivore, H = Herbivore, O = Omnivore, D = Detritivore);
Water Type (B = Black, W = White, C = Clear);
Abundance (R = Rare, U = Uncommon, C = Common, A = Abundant);
Distribution (A = both mountains and llanos, B = llanos, blackwater habitats, L = llanos, widespread, M = mountains and/or piedmont, R = llanos, large rivers.

Anostomidae (12 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Abramites hypselonotus	r1	H	W	U	R
Anostomus ternetzi	r1	O	B,C	U	B
Leporellus vittatus	r2	O	W,C	U	M
Leporinus cf granti	r2	H	B,C	R	B
Leporinus friderici	r2	O	W,C,B	C	L
Leporinus sp.	r2	O	W,C,B	C	L
Leporinus sp. "aguaro"	r2	O	B	R	B
Leporinus striatus	r2	O	W,C	C	M
Leporinus yophorus	r2	O	W	U	L
Pseudanos gracilis	r1	O	B	R	B
Pseudanos irinae	r1	O	B,C	U	B
Schizodon isognathus	r2	H	W,C,B	C	L

Characidae (88 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Acestrocephalus cf boehlkei	r1	C	W	U	R
Acestrorhynchus falcirostris	r1	C	B	R	B
Acestrorhynchus sp "pico largo"	r1	C	B	R	B
Acestrorhynchus microlepis	r1	C	W,C,B	C	B
Aphyocharax alburnus	r1	O	W,C,B	A	A
Astyanax bimaculatus	r2	O	W,C,B	A	A
Astyanax integer	r2	O	W,C,B	C	A
Astyanax metae	r2	O	W,C	C	M
Astyanax polylepis	r2	O	B,C,	C	B
Astyanax superbus	r2	O	W,C	U	M
Astyanax venezuelae	r2	O	W,C	U	M
Brycon bicolor	r2	O	B,C	R	B
Brycon whitei	r2	O	W,C,B	U	M
Bryconamericus sp.	r1	O	W	C	L
Bryconamericus beta	r1	O	W	C	A
Bryconamericus deuterodonoides	r1	O	W,C	C	M
Bryconops affinis	r1	C	B	R	B
Bryconops melanurus	r1	C	B	U	B
Catoprion mento	r2	C	B	U	B
Charax gibbosus	r2	C	W,C,B	C	L
Cheirodon pulcher	r1	O	W,C,B	A	A
Cheirodontops geayi	r2	C	W	C	A
Colossoma macropomum	r2	H	W,C	C	L
Corynopoma riisei	r1	C	W,C	C	M
Creagrutus cf beni	r1	O	W,C	C	M
Creagrutus bolivari	r1	O	W,C	C	A

Table 4. (continued).

Characidae (continued)

Species	Strategy	Diet	Water	Abun.	Dist.
Creagrutus n. sp.	r1	O	W,C	C	M
Ctenobrycon spilurus	r1	O	W,C,B	A	L
Cynopotamus bipunctatus	r2	C	W	C	L
Engraulisoma cf taeniatum	r1	C	W,C	C	A
Galeocharax sp.	r2	C	W	U	R
Gephyrocharax valenciae	r1	C	W,C,B	A	A
Gnathocharax steindachneri	r1	C	B	R	B
Gymnocorymbus thayeri	r1	O	B,C	C	B
Hemibrycon metae	r2	O	W,C	C	M
Hemigrammus analis	r1	O	B	U	B
Hemigrammus barrigonae	r1	O	B,C	C	B
Hemigrammus cf elegans	r1	O	B	U	B
Hemigrammus marginatus	r1	O	W,C,B	C	A
Hemigrammus micropterus	r1	O	B	C	B
Hemigrammus microstomus	r1	O	B	U	B
Hemigrammus cf mimus	r1	O	B	R	B
Hemigrammus newboldi	r1	O	B	U	B
Hemigrammus cf rhodostomus	r1	O	B	R	B
Hemigrammus cf schmardae	r1	O	B	U	B
Hemigrammus sp. "arriba"	r1	O	W,C,B	C	L
Hemigrammus stictus	r1	O	B	R	B
Heterocharax macrolepis	r1	C	B	R	B
Hyphessobrycon bentosi	r1	O	B	U	B
Hyphessobrycon metae	r1	O	B	C	B
Iguanodectes spilurus	r1	O	B	U	B
Markiana geayi	r2	O	W,C,B	C	L
Megalamphodus cf axelrodi	r1	O	W,C	U	L
Metynnis argenteus	r2	O	B	U	B
Metynnis hypsauchen	r2	O	B	R	B
Metynnis luna	r2	O	B	U	B
Microschemobrycon casiquiare	r1	O	B	U	B
Moenkhausia chrysargyrea	r1	O	B	U	B
Moenkhausia copei	r1	O	B	C	B
Moenkhausia dichroura	r1	O	W,C,B	C	L
Moenkhausia lepidura complex	r1	O	W,C,B	C	L
Myleus cf pacu	r2	O	B	R	B
Myleus rubripinnis	r2	O	B	U	B
Mylossoma aureum	r2	H	W,C,B	R	L
Mylossoma duriventris	r2	H	W,C,B	C	L
Paragoniates alburnus	r2	C	W	C	A
Parapristella georgiae	r1	C	B	U	B
Phenacogaster megalostictus	r1	C	B	U	B
Piaractus brachypomus	r2	O	W,C,B	C	L
Poptella orbicularis	r1	O	W,C,B	C	L
Pristobrycon striolatus	r2	C	B	U	B
Pygocentrus caribe	r2	C	W,C,B	C	L
Pygopristis denticulatus	r2	O	B	R	B
Roeboides affinis	r1	C	W,C,B	C	L
Roeboides dayi	r1	C	W,C,B	A	L
Salminus hilarii	r2	C	W,C	U	M

Table 4. (continued).

Characidae (continued)

Species	Strategy	Diet	Water	Abun.	Dist.
Serrabrycon magoi	r1	C	B	R	B
Serrasalmus altuvei	r2	C	B	U	B
Serrasalmus medinai	r2	C	W,C,B	C	L
Serrasalmus elongatus	r2	C	B	U	B
Serrasalmus irritans	r2	C	W,C,B	C	L
Serrasalmus rhombeus	r2	C	W,C,B	C	L
Tetragonopterus argenteus	r2	O	W,C,B	C	L
Triportheus albus	r2	O	W	R	R
Triportheus angulatus	r2	O	W,C,B	C	L
Triportheus sp. "cola roja"	r2	O	W,C,B	C	L
Xenagoniates bondi	r1	C	W,C,B	C	L
Unidentified	r1	O	W	R	L

Characidiidae (11 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Ammocryptocharax elegans	r1	O	B	R	B
Characidium cf zebra	r1	O	B,C,	C	L
Characidium sp. D	r1	O	B	U	B
Characidium chupa	r1	O	W	R	M
Characidium sp. K	r1	O	W,C	R	L
Characidium sp. J	r1	O	B	R	B
Characidium cf catenatum	r1	O	W,C,B	A	A
Characidium sp. G	r1	O	W,C,B	A	L
Characidium voladorita	r1	O	W	C	M
Elachocharax junki	r1	O	B	R	B
Elachocharax pulcher	r1	O	B	R	B

Chilodontidae (1 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Chilodus punctatus	r1	O	B	U	B

Ctenoluciidae (1 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Boulengerella lucia	r2	C	B,C	R	B

Curimatidae (8 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Steindachnerina sp.	r2	D	W,C,B	C	L
Steindachnerina argentea	r2	D	W,C,B	A	L
Curimata cerasina	r2	D	W	C	L
Cyphocharax spilurus	r2	D	B,C	C	B
Curimatella bolivarensis	r2	D	B,C	R	B
Curimatella immaculata	r2	D	B,C	C	B
Potamorhina altamazonica	r2	D	W	R	R
Psectrogaster ciliatus	r2	D	B	U	B

Table 4. (continued).

Cynodontidae (3 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Hydrolycus scomberoides	r2	C	W,C,B	C	L
Rhaphiodon gibbus	r2	C	W,C,B	U	L
Rhaphiodon vulpinus	r2	C	W,C,B	C	L

Erythrinidae (3 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Hoplerythrinus unitaeniatus	r2	C	W,C,B	C	L
Hoplias macrophthalmus	r2	C	B	R	B
Hoplias malabaricus	r2	C	W,C,B	A	L

Gasteropelecidae (1 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Thoracocharax stellatus	r2	C	W,C,B	A	L

Hemiodontidae (2 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Hemiodopsis argenteus	r2	O	B	R	B
Hemiodopsis gracilis	r2	O	B	R	B

Lebiasinidae (3 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Copella metae	r1	C	B	C	B
Lebiasina erythrinoides	r2	O	W,C	C	M
Pyrrhulina cf lugubris	r1	O	W,C,B	C	A

Parodontidae (2 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Parodon sp. linea	r2	O	W,C	C	L
Parodon apolinari	r2	O	W,C	C	M

Prochilodontidae (2 species)

Species	Strategy	Diet	Water	Abun.	Dist.
Prochilodus mariae	r2	D	W,C,B	A	A
Semaprochilodus kneri	r2	D	B,C	R	B

Distribution within the Apure drainage.

Although each characiform species has specific, perhaps unique habitat requirements that in most cases are yet to be ascertained, two basic environmental parameters determine species distribution within the Apure River drainage: altitude and water type.

The effects of an altitude gradient on fishes has been studied in many areas (Balon & Stewart 1983). It could just as well be labeled a slope, temperature or substrate gradient, since all of these parameters vary with altitude, and the fishes undoubtedly respond to the combined effect of these and other associated habitat parameters. Examination of the species distribution maps reveals that of the 137 species present, 16 (12%) are completely restricted to montane habitats (eg. Characidium voladorita, Parodon apolinari, and Creagrutus cf beni), fourteen more (10%) use montane and well as llaneran habitats, for a total of 30 species of characiforms in the mountains and piedmont regions. There are finer divisions within these broad categories. For example, Corynopoma riisei is found only in the clearer streams of forested piedmont areas. (See the individual species accounts for more detailed information). Most species (107 of 137, or 78%) seldom or never venture out of the llanos (eg. Charax gibbosus, Moenkhausia dichroura). Combined with the 14 species that use both high and lowlands, a total of 121 (88%) use lowland, llaneran habitats. Of the 107 strictly lowland species collected, five are usually found in or near large rivers, 43 are widespread throughout the llanos, and 60 are found mostly in blackwater habitats (47 exclusively so). In Table 5, I have listed the Apure drainage characiforms that are restricted to the mountains and piedmont.

Table 5. Characiforms restricted to montane and piedmont habitats.

Anostomidae	Leporellus vittatus
"	Leporinus striatus
Characidae	Astyanax metae
"	Astyanax superbus
"	Astyanax venezuelae
"	Brycon whitei-1
"	Bryconamericus deuterodonoides
"	Corynopoma riisei
"	Creagrutus cf beni
"	Creagrutus n sp.
"	Hemibrycon metae
"	Salminus hilarii-2
Characidiidae	Characidium chupa
"	Characidium voladorita
Lebiasinidae	Lebiasina erythrinoides
Parodontidae	Parodon apolinari

1. A population of Brycon tentatively identified as Brycon whitei exists in the lowland, blackwater Aguaro-Guariquito system. Upon further examination that population will probably be determined as taxonomically distinct from the Andean species.

2. Salminus hilarii juveniles have been collected from llaneran streams, but adults have so far only been found in the Andes. The juveniles may wash down with floodwaters, and then make there way back upstream after they have grown.

The second basic parameter controlling fish distribution is water type. About 44% (60 species) of the 137 characiforms present in the Apure drainage occur only (or mostly) in blackwater habitats (eg. Copella metae, Hemigrammus cf rhodostomus, Anostomus ternetzi). Whether they are responding directly to some specific water quality parameter found in such habitats, such as higher water clarity (visibility), lower pH values, lack of dissolved minerals (low conductivity), or to some indirect result of these such as increased aquatic macrophyte populations, different food sources, a sand versus mud substrate is not known. While certain parameters may effect fish distribution more than

others, fishes respond to the ecosystem as a complex whole. In the ecological section it was shown that aquatic ecosystems in the llanos fluctuate seasonally. The water quality parameters mentioned above and many others such as depth, dissolved oxygen concentration, etc., all run through an annual cycle of change in accord with the wet and dry season. Thus, the individual dot maps of distribution reflect an average annual distribution, rather than precise geographical limits for each species. In fact, some of the sites shown would be completely dry during part of the year. In spite of these limitations, the maps show a fairly clear pattern of distribution for most species. In particular the division of fish distributions in white and blackwater faunas is one of the most obvious, and is repeated time and again for many species in several different families. There are three disjunct areas in the Apure drainage where blackwater habitats exist: northern Apure state in the Guaritico River system, (Balsa, Caicara and Guaritico Creeks), central Barinas state in the region south of Ticoporo, and the Aguaro-Guariquito system of Guárico state. All three areas are characterized by white-sand soils, and are drained by streams that originate in the llanos (although in Barinas, Andean streams also pass through the region, but these tend to come from forested areas and carry fewer sediments that other Andean headwater streams).

Tallying the data in Table 4 for those species present in each water type we find 77 (56% of 137 total) species using whitewater habitats, 103 (75%) from blackwater streams, and 74 (54%) that were found in clear water. Since fishing effort was much more intense in the most common whitewater habitat, it is at first surprising to find more species entering blackwater systems. However, if those species that

occur only in blackwater habitats (which I have interpreted as the older fauna, derived from the ancient Guyana Shield fish fauna) are so specialized as to be restricted to the same, then we would expect more species that are restricted to black water than to white water. It follows then, if the whitewater species evolved more recently to exploit the geologically young (late Pleistocene), and much more productive alluvial deposits of the llanos, that they should be more generalized and opportunistic, and able to take advantage of any situation they find themselves in. Only 15 species are restricted to whitewater habitats. Looking at the data another way, we find only 15 species found only in (apparently restricted to) whitewater habitats, none to clearwater habitats (probably because there are so few [perhaps none] year-round clearwater habitats here), but 47 in blackwater habitats. Species that use all three water types numbered 43, 13 were found in both black and clearwater habitats, and 19 were found in white and clearwater habitats. Lumping whitewater with white and clearwater streams gives us 33 species, but lumping blackwater with black and clearwater inhabitants gives us 60, or almost twice as many. These numbers indicate that those species in blackwater systems are more restricted to the same than those using whitewater systems.

Of the 60 species that are mostly restricted to blackwater habitats (Table 6) 49 (82% of all blackwater species) are present in the Aguaro-Guariquito system, 31 (52%) in northern Apure state, and 14 (23%) in central Barinas. Although sampling could have been more thorough, a pattern of decreasing numbers of blackwater species from east to west emerges. Major blackwater habitats exist in the rivers draining the Guyana Shield to the southeast, and also in the Capanaparo and Cinaruco

Rivers of southern Apure state. The simplest explanation for the observed pattern is that river distance determines how many species have been able to invade the three "islands" of suitable blackwater habitat (in a sea of muddy, whitewater rivers) from the probable source areas, the Guyana Shield and the rivers of southern Apure state. Since the llanos are geologically very young, species from the ancient (600 million years) Guyana Shield blackwater habitats may not yet have had adequate time to disperse into all suitable habitats.

Zoogeographical Considerations

The Apure drainage forms a small part of the Orinoco Basin. To understand how the fishes we currently find there may have arrived, as well as how they have adapted to the conditions they found there, it is necessary consider the Apure drainage in the larger context of the Orinoco Basin, and to consider the history of the Orinoco Basin itself. Today, the Apure river drainage is sandwiched between the Andes Mountains to the north and west, and the Guyana Shield to the southeast. Its soils are a mixture of Quaternary sediments that originated in the Andes and older sandier soils that were washed down from the Guyana Shield (or perhaps blown in from there during more arid periods) (R. Schargel, pers. com.). To understand the zoogeographical history of the Apure drainage, we must first understand that of the Orinoco Basin.

Unfortunately, various factors create difficulties in the zoogeographic analysis of any portion of the South American ichthyofauna (generally poor taxonomic knowledge at both generic and species levels, incomplete collections coverage, and very few complete phylogenetic histories for most fishes). Although the Apure River drainage has now been more thoroughly sampled than probably any other area of comparable

Table 6. List of 59 blackwater species, with an indication of their presence (X) or absence (-) in the three main regions where blackwater habitats occur in the Apure drainage.

	Barinas	Apure	Guárico
Anostomidae			
Anostomus ternetzi	-	X	X
Leporinus cf granti	-	-	X
Leporinus sp. "aguaro"	-	-	X
Pseudanos gracilis	-	-	X
Pseudanos irinae	X	X	-
Characidae			
Acestrorhynchus falcirostris	-	-	X
Acestrorhynchus sp. "pico largo	-	X	-
Acestrorhynchus microlepis	X	X	X
Astyanax polylepis	X	X	X
Brycon bicolor	-	-	X
Brycon "whitei"	-	-	X
Bryconops affinis	-	-	X
Bryconops melanurus	-	-	X
Catoprion mento	-	X	X
Gnathocharax steindachneri	-	-	X
Gymnocorymbus thayeri	X	X	X
Hemigrammus analis	-	-	X
Hemigrammus barrigonae	X	X	X
Hemigrammus elegans	-	X	X
Hemigrammus micropterus	X	X	X
Hemigrammus microstomus	-	-	X
Hemigrammus cf mimus	X	X	-
Hemigrammus newboldi	X	X	X
Hemigrammus cf rhodostomus	-	-	X
Hemigrammus cf schmardae	-	-	X
Hemigrammus stictus	-	-	X
Heterocharax macrolepis	-	-	X
Hyphessobrycon bentosi	-	X	X
Hyphessobrycon metae	X	X	X
Iguanodectes spilurus	-	X	X
Metynnis argenteus	-	X	X
Metynnis hypsauchen	-	-	X
Metynnis luna	-	X	X
Microschemobrycon casiquiare	-	-	X
Moenkhausia chrysargyrea	X	-	X
Moenkhausia copei	X	X	X
Myleus sp	-	-	X
Myleus rubripinnis	-	X	X
Parapristella georgiae	-	-	X
Phenacogaster cf megalostictus	-	X	X
Pristobrycon striolatus	-	X	-
Pygopristis denticulatus	-	-	X
Serrabrycon magoi	-	-	X
Serrasalmus altuvei	-	X	-
Serrasalmus elongatus	-	X	X

Table 6. (continued).

	Barinas	Apure	Guárico
Characidiidae			
Ammocryptocharax elegans	-	-	X
Characidium sp. D	-	X	X
Characidium sp. J	-	-	X
Hoplias macrophthalmus	-	-	X
Copella metae	-	-	X
Chilodontidae			
Chilodus punctatus	-	X	-
Hemiodontidae			
Hemiodopsis argenteus	-	X	-
Hemiodopsis gracilis	-	-	X
Curimatidae			
Cyphocharax spilurus	X	X	X
Curimatella bolivarensis	X	X	-
Curimatella inmaculata	-	X	X
Psectrogaster ciliatus	-	X	-
Prochilodontidae			
Semaprochilodus kneri	-	-	X

	Barinas	Apure	Guárico
total number of species:	13	30	49
percent:	22	51	83

size in South America, the dearth of collections from other portions of the Orinoco basin, as well as from neighboring river basins, permit only tentative zoogeographic conclusions at this time.

Another factor is our incomplete knowledge of the geological and hydrological history of northern South America, although recent work by Duque-Caro (1989) permits some preliminary conclusions to be drawn, which are summarized below. The history of Andean orogeny begins in the middle Eocene, when intermontane basins began to take shape, and the emergence of the Cordillera Central divided northern South America into eastern and western regions. The Guyana Shield and the Cordillera

Oriental, the latter of which extend from west to east through Venezuela out towards Trinidad, had already partially emerged by this time. Major paleogeographic and paleo-oceanographic events during the middle Miocene further shaped the drainages in this region, and by the Middle Pliocene events had proceeded to the point that mountain ranges and river basins had, to a large degree, attained their present-day configurations. During the formative stages, before the Andean uplift had proceeded very far, there is evidence that a major river ran north from southern Colombia, or perhaps even northern Ecuador, out through the present-day Magdalena Basin and Panama (the Central American land bridge had not yet emerged at this time.

Fossil evidence indicates that serrasalmines and other fishes now extinct west of the Andes were present in the region at that time. As the Andes rose, this river's delta migrated eastward, possibly flowing into the Caribbean first through what is now the Maracaibo Basin, and then through central Falcon state in Venezuela, and the Unare drainage area in eastern Venezuela, to finally reach its present day delta near Trinidad. This scenario is greatly oversimplified, (eg., parts of the area were flooded by ocean during part of this time), but in the absence of more precise geological information it can serve as a working hypothesis.

The similarities of the characiform fishes found today in the Apure drainage clearly indicate a closer relationship between the ichthyofaunas east of the Andes than with those west of the Andes.

To get an initial idea of the possible relationships and origins of the Apure drainage fishes, one can compare the lists that are available in the literature for neighboring drainages. Eigenmann was

always concerned with the origin of fish faunas as well as their taxonomy and diversity, and published many lists of the fish species occurring in different drainage areas. In his work on the fishes of British Guiana (1912) he published such a list comparing the Orinoco Basin fishes then known (only 89 species!) with the 470 species he obtained from Guyana (then British Guiana). Using the admittedly incomplete (taxonomically) list of characiform species for the Apure River drainage in Venezuela presented here as the starting point, Table 7 was constructed to compare Apure fishes with those reported from surrounding drainages for which lists are available. Lists for the Guyana made by Eigenmann (1912), for the Río Negro in Brazil (Goulding 1988), from the Maracaibo Drainage in Venezuela (Taphorn & Lilyestrom 1984), and from the Magdalena Drainage of northern Colombia (Dahl 1971) were used. For some records of species not in the original lists were included, based on more recent collections of my own or reported in the literature. Although the limitations listed above are serious, a fairly clear pattern of faunal similarity emerges. The Apure River drainage shared many more families, genera, and species with the Río Negro drainage and Essequibo Basin, than with the Maracaibo or Magdalena basins on the other side of the Andes.

As can be seen in the summary of the data at the end of Table 7, of the thirteen families present in the Apure drainage the Chilodontidae, Cynodontidae and Hemiodontidae are absent from both the Magdalena and Maracaibo basins. Genera provide the most useful information regarding affinities of the Apure drainage characiform fishes. Of the 77 genera present, only about 20 occur today west of the Andes. More than 76% of the genera present in the Apure drainage are also found in

the Amazonian blackwater tributary, the Río Negro, and about 64% are shared with the Essequibo drainage in Guyana. Since specific identifications are usually tentative, little more than a general trend can be detected with such an analysis. Probably the most important information to convey, however, is that only seven or eight species are common to both sides of the Andes, whereas between 25-30% of the Apure species are common to Guyana or the Río Negro.

It seems clear then that the Apure drainage characiform fish fauna is comprised of both old and new elements. The old elements were probably present in the Guyana Shield region long before the Apure drainage was formed. If a complete species list were available for the upper Orinoco, I suspect that many more species and genera would be found in common with the Apure fauna than is true for the Río Negro. The high degree of similarity between the Apure characiforms and the Río Negro species is due to the large number of blackwater species found in isolated patches in the former. Those species have probably dispersed from the Shield into the Apure drainage. The newer element of the Apure drainage fish fauna consists of species that have evolved there. One group has specialized in utilizing mountain and piedmont habitats, and another evolved to take advantage of lowland, whitewater rivers. This mixture of origins probably accounts in part for the relatively high species diversity observed.

Table 7. Zoogeographical comparison of the Apure Drainage characiform ichthyofauna. Comparisons are given for the Magdalena Basin of northern Colombia (Magd.); the Maracaibo Basin of northwestern Venezuela (Mara.); the Essequibo and Demerara Basins of Guyana (Guya.); and the Río Negro Drainage of northern Brazil (Negr.). Taxa in common are indicated by F = Family, G = Genus and S = Species. Sources are indicated in text. An asterisk indicates that the taxa was not mentioned in the original source but is included based on subsequent records.

	Magd.	Mara.	Guya.	Negr.
Anostomidae	F	F	F	F
Abramites hypselonotus	S		S	S
Anostomus ternetzi			G	S
Leporellus vittatus	S			
Leporinus cf granti			S	S*
Leporinus friderici			S	S
Leporinus sp.				
Leporinus sp. "aguaro"				
Leporinus striatus	S			
Leporinus yophorus				
Pseudanos gracilis				S
Pseudanos irinae				S
Schizodon isognathus		G	G	G
Characidae	F	F	F	F
Acestrocephalus cf boehlkei	G			G
Acestrorhynchus falcirostris			S	S
Acestrorhynchus sp "pico largo"				
Acestrorhynchus microlepis			S	S
Aphyocharax alburnus			G	S*
Astyanax bimaculatus	S	G	S	G
Astyanax integer				
Astyanax metae				
Astyanax polylepis			S	
Astyanax superbus				
Astyanax venezuelae				
Brycon bicolor		G	G	G
Brycon whitei	S			
Bryconamericus sp.	G		G	G
Bryconamericus beta		S		
Bryconamericus deuterodonoides				
Bryconops affinis			S	
Bryconops melanurus			S	S
Catoprion mento			S	S
Charax gibbosus			S	S
Cheirodon pulcher	G	G	G	G
Cheirodontops geayi				
Colossoma macropomum				
Corynopoma riisei				
Creagrutus cf beni	S	S	S	G
Creagrutus bolivari				
Creagrutus n. sp.				
Ctenobrycon spilurus			S	
Cynopotamus bipunctatus		G	G	
Engraulisoma cf taeniatum				

Table 7. Continued.

	Magd.	Mara.	Guya.	Negr.
Galeocharax sp.				
Gephyrocharax valenciae	G	G		
Gnathocharax steindachneri				S
Gymnocorymbus thayeri				
Hemibrycon metae	G	G		
Hemigrammus analis			S	S
Characidae (continued)				
Hemigrammus barrigonae				
Hemigrammus cf elegans				S*
Hemigrammus marginatus				
Hemigrammus micropterus				
Hemigrammus microstomus				
Hemigrammus cf mimus				S
Hemigrammus newboldi				
Hemigrammus cf rhodostomus				S
Hemigrammus cf schmardae				
Hemigrammus sp. "arriba"				
Hemigrammus stictus			S	S
Heterocharax macrolepis			S	S
Hyphessobrycon bentosi	G	G	G	G
Hyphessobrycon metae				
Iguanodectes spilurus			G	S
Markiana geayi				
Megalamphodus cf axelrodi				
Metynnis argenteus				G
Metynnis hypsauchen			S	
Metynnis luna				
Microschemobrycon casiquiare				S
Moenkhausia chrysargyrea			S	
Moenkhausia copei			S	
Moenkhausia dichroura			S	
Moenkhausia lepidura complex			S	S
Myleus cf pacu			S	G
Myleus rubripinnis			S	S*
Mylossoma aureum		G		
Mylossoma duriventris				
Paragoniates alburnus				
Parapristella georgiae			G	G
Phenacogaster cf megalostictus			S	G
Piaractus brachypomus				G*
Poptella orbicularis			S	S
Pristobrycon striolatus				G*
Pygocentrus caribe			G	G*
Pygopristis denticulatus			S	S*
Roeboides affinis			G	G
Roeboides dayi	S	S		
Salminus hilarii	G			
Serrabrycon magoi				S
Serrasalmus altuvei				
Serrasalmus elongatus				
Serrasalmus irritans				
Serrasalmus medinai				

Table 7. Continued.

	Magd.	Mara.	Guya.	Negr.
Characidae (continued)				
Serrasalmus rhombeus			S	S*
Tetragonopterus argenteus			S	G
Triportheus albus			G	
Triportheus angulatus				S
Triportheus sp. "cola roja"				
Xenagoniates bondi				
Characidiidae	F	F	F	F
Ammocryptocharax elegans				S
Characidium cf catenatum	G		S	G
Characidium chupa		S		
Characidium sp. D				
Characidium sp. G				
Characidium sp. K				
Characidium sp. J				
Characidium voladorita		S		
Characidium cf zebra				
Elachocharax junki				S*
Elachocharax pulcher				S
Chilodontidae			F	F
Chilodus punctatus			S	S
Ctenoluciidae	F	F	F	F
Boulengerella lucia			G	S
Curimatidae	F	F	F	F
Curimata cerasina	G	G	G	G
Curimatella bolivarensis			G	G
Curimatella immaculata				
Cyphocharax spilurus			S	S
Potamorhina altamazonica		G		G
Psectrogaster ciliatus			S	G*
Steindachnerina argentea			G	G
Steindachnerina sp.				
Cynodontidae			F	F
Hydrolycus scomberoides			S	S
Rhaphiodon gibbus			S	S*
Rhaphiodon vulpinus				S
Erythrinidae	F	F	F	F
Hoplerythrinus unitaeniatus			S	
Hoplias macrophthalmus			S	S*
Hoplias malabaricus	S	S	S	S*
Gasteropelecidae	F	F	F	F
Thoracocharax stellatus				

Table 7. Continued.

	Magd.	Mara.	Guya.	Negr.
Hemiodontidae			F	F
Hemiodopsis argenteus			G	G*
Hemiodopsis gracilis				
Lebiasinidae	F	F	F	F
Copella metae				G
Lebiasina erythrinoides	G	S	G	G*
Pyrrhulina cf lugubris			G	G
Parodontidae	F	F	F	F
Parodon sp. linea	G	G	G	G*
Parodon apolinari				
Prochilodontidae	F	F	F	F
Prochilodus mariae	G	G	G	G
Semaprochilodus kneri				G*

	present in Apure	Number Shared with Magd.	Mara.	Guya.	Negr.
Families	13	10	10	13	13
Genera	77	20	19	49	59
Species	138	8	7	37	39

LITERATURE CITED

Agassiz, L. 1829. Selecta genera et species Piscium quos in itinere per Brasiliam (1817-1820), collegit et pigendos J.B. Spix, Munich.

Ahl, E. 1922. Die Gattung Mylossoma Eigenmann. Wochen. Aquar. Terrar., 19(11):203-204.

_____. 1923 (1924). Ichthyologische Mitteilungen. I. Eine Revision der Characiniden-Gattung Metynnis. Mitt. Zool. Mus., Berlin, 2:15-31.

_____. 1924. Uber eine farbenprachtige Neuheit, Hemigrammus rhodostomus sp. nov. Wochenschr. Aquar. Terrar., 21 (18).

Angermeier,P. & J. Karr. 1983. Fish communities along environmental gradients in a system of tropical streams. Environmental Biology of Fishes, 9(2):117-135.

Anonymous. 1983. La Pesca en el Orinoco. Ambiente, 4(7):17-28.

Axelrod, H. 1959. Publisher's Letter. Trop. Fish Hobbyist 7(5):3.

Axelrod, H., C. Emmens, D. Sculthorpe, W. Vorderwinkler, N. Pronek 1971. EXOTIC TROPICAL FISHES. T.F.H. Pub., Jersey City, New Jersey. (with monthly supplements).

Azevedo, P. de & A. Gomes. 1943. Contribucâo ao estudo da biologia de Traira Hoplias malabaricus (Bloch) 1794, Bolm. Ind. Anim. S. Paulo n.s., 5:15-64.

Azuma, H. 1975. Spawning the red-bellied piranha, Serrasalmus nattereri. Tropical Fish Hobbyist 23(11):4-15,96-98.

Baird, S. & Ch. Girard. 1854. Descriptions of new species of fishes collected in Texas, New Mexico and Sonora, by John H. Clark on the U. S. and Mexican Boundary Survey and in Texas by Capt. Stewart van Vliet, USA. Proc. Acad. Nat. Sci. Philadelphia, 24-29.

Balon, E. & D. Stewart. 1983. Fish assemblages in a river with unusual gradient (Luongo, Africa--Zaire system), reflections on river zonation, and description of another new species. Environmental Biology of Fishes, 9(3/4):225-252.

Barbarino D., A. & D. Taphorn. 1989. Estudio de las migraciones y densidades poblacionales del coporo (Prochilodus mariae) y otras especies migratorios en el embalse Boconó-Tucupido y Areas Adyacentes. Informe REUNELLEZ, 1-95, Barinas.

Bayley, P. 1973. Studies on the migratory characin, Prochilodus platensis Holberg 1889 (Pisces, Characoidei) in the river Pilcomayo, South America. J. Fish Biol., 5 (25):1-40.

Berg, C. 1895. Sobre peces de agua dulce nuevos o poco conocidos de la Republica Argentina. Ann. Mus. Nac. Buenos Aires, 4:121-165.

_____. 1897. Contribuciones al conocimiento de los peces sudamericanos, especialmente de los de la Republica Argentina. Ann. Mus. Nac. Buenos Aires, 5(1896):263-302.

_____. 1899. Comunicaciones ictiológicas II. Com. Mus. Nac. Buenos Ayres 4:91-97.

Bertoni, A. de W. 1914. Fauna Paraguaya. Catálogos sistemáticos de los vertebrados de Paraguay. in Moises S. Bertoni (Helveticus), Descripción física y económica del Paraguay. Asunción, Num. nov. 59:1-86.

_____. 1939. Catálogos sistemáticos de los vertebrados de Paraguay. Clase quinta, Peces. Rev. Soc. Cien. Paraguay 4(4):50-58.

Blëher, H. 1986. The return of the Wimple Piranha. Tropical Fish Hobbyist, 34(8):82.

Bloch, M. (1785-1795). Natürgeschichte der Auslandische Fische. Parts 1-9, atlas, n.p., Berlin.

Bloch, M. & J. Schneider. 1801. M. E. Blochii...Systema ichthyologiae iconibus ex illustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit, J.G. Schneider. 2 Vols., Berlin.

Böhlke, J. 1952. Studies on fishes of the family Characidae.- No. 1. A new genus of cheirodontine Characid from the Canal de Casiquiare and adjacent waters in Venezuela and Northern Brazil. Ann. Mag. Nat. Hist. London, 12(5):775-777.

_____. 1953a. A catalogue of the type specimens of recent fishes in the Natural History Museum of Stanford University. Stanford Ich. Bull., 5:1-167.

_____. 1953b. Studies on Fishes of the Family Characidae.- No. 5. A review of the genus Microschemobrycon with descriptions of two new species. Ann. Mag. Nat. Hist. London, 12(6):841-850.

_____. 1954. Studies on Fishes of the Family Characidae.- No. 6. A synopsis of the Iguanodectinae. Ann. Mag. Nat. Hist. London, 12(7):97- 103.

_____. 1955a. Studies on Fishes of the Family Characidae.- No. 8. The description of a new Hemigrammus from the Rio Negro of Brazil. Trans. Kansas Acad. Sci., 58(1):229-235.

_____. 1955b. Studies on Fishes of the Family Characidae.- No. 9. Notes on the distribution, variation and type locality of Gnathocharax steindachneri Fowler. Notulae Naturae, 277:1-14

_____. 1955c. Studies on Fishes of the Family Characidae.- No. 10. Notes on the coloration of the species of Hemiodus, Pterohemiodus and Anisitsia, with the description of a new Hemiodus from the Rio Negro at the Brazil-Colombia Border. Notulae Naturae, (278):1-15.

_____. 1958. Studies on Fishes of the Family Characidae.- No. 14. A report on several extensive recent collections from Ecuador. Proc. Acad. Nat. Sci. Philadelphia, 110:1-121.

Borodin, N. 1929. Notes on some species and subspecies of the genus Leporinus Spix. Mem. Mus. Comp. Zool., 50 (3):269-290.

_____. 1931. On the genus Anostomus (Family Characinidae). Bull. Mus. Comp. Zool., 72(2):3752.

Bosc, L. 1817. Nouveau dictionnaire d'Histoire naturelle. 1-560 Paris.

Boulenger, G. 1895. Viaggio del dottor Alfredo Borelli nella Republica Argentina e new Paraguay. XII. Poissons. Boll. Mus Zool. Anat Comp. Torino, 10(196):1-3.

_____. 1896. On a collection of fishes from the Rio Paraguay. Trans. Zool. Soc. London, 14(2):25-39.

_____. 1898. On a collection of fishes from the rio Jurua, Brazil. Trans. Zool. Soc. London, 14:421-428.

_____. 1900. Viaggio del Dr. A. Borelli nel Matto Grosso e nel Paraguay. III Liste des poissons recuillis a Urucum et a Carandasinho, pres de Corumba. Boll. Mus. Zool. Anat. Comp. Torino, 15(370):1-4.

Braga, L. & M. Azpelicueta. 1983. Semitapicis squamoralevis sp. nov. (Osteichthys: Curimatidae) con consideraciones sobre el género. Studies on Neotropical Fauna and Flora, 18:139-150.

Brandy III, G. & D. Campbell. 1984. Some notes on spawning and rearing the red-bellied piranha. Aquarium 7(7):21.

Britski, H. 1969. Lista dos tipos de peixes das colecoes do departamento de Zoologia da Secretaria da Agricultura de São Paulo. Pap. Avuls. Zool. S. Paulo, 22 (19):197-215.

Cala C., P. 1977. Los peces de la Orinoquía Colombiana. Lozánia 24, 1-21.

Campos, A. Amaral. 1944. Peixes da subfamilia Mylinae existentes na colecao do departamento de Zoologia da Secretaria da Agricultura de São Paulo. Pap. Avuls. Zool. S. Paulo, 4(14):197-212.

_____. 1945. Contribuicao ao conhencimento das especies brasileiras do genero Hydrocynus e afins. Arq. Zool. Est. S. Paulo, 4 (12) 467-484.

_____. 1946. Novo genero e novas espécies de caracidos do baixo amazonas. Pap. Avuls. Zool. S. Paulo, 7(17):217-220.

Castelnau F. 1855. Animaux nouveaux ou rares, recueillis pendant l'expédition dans les parties centrales de l'Amérique du Sud. Poissons.

Castro, R. 1981. Engraulisoma taeniatum um novo gênero e espécie de Characidae da Bacia do Rio Paraguai (Pisces, Ostariophysi). Pap. Avuls. Zool., S. Paulo, 34(11):135-139.

Cervigón M., F. 1966. Los Peces Marinos de Venezuela. Tomos I y II, Monografía 11, Fund. La Salle Cien. Nat., 1-952. Caracas.

_____. 1968. Los Peces Marinos de Venezuela. Complemento I. Mem. Soc. Cien. Nat. La Salle, 27(31):177-218.

_____. 1982. La Ictiofauna Estuarina del Caño Mánamo y Areas Adyacentes. in Los recursos pesqueros del rio orinoco y su explotacion, (D. Novoa editor). Corp. Venez. Guayana, Editorial Arte, Caracas, 1-386.

Cope, E. 1870. Contribution to the ichthyology of the Marañon. Proc. Amer. Phil. Soc. Philadelphia, 11:559-570.

_____. 1872. On the Fishes of the Ambyiacu River. Proc. Acad. Nat. Sci. Philadelphia (for 1871), 13:249-294.

_____. 1878. Synopsis of the fishes of the Peruvian Amazon by Professor Orton during his expedition of 1873 and 1877. Proc. Amer. Phil. Soc. Philadelphia, 17:673-701.

_____. 1894. On three new genera of Characinidae. Amer. Nat. (Zool.), 28:67.

Cuvier G. 1817. Le regne animal distribue d'apres son organisation. tome II (Reptiles, Poissons, etc.) n.p., Paris.

_____. 1818. Sur les poissons du sous-genre Myletes. Mem. Mus. Hist. Nat. Paris, 4:444-456.

_____. 1819. Poissons du sous-genre Hydrocyon, sur deux nouvelles especes de Chalceus, sur trois nouvelles especes de Serrasalmes, et sur l' Argentina glossodonta de forskahl, qui est l' Albula gonorhynchus de Bloch. Mem. Mus. Hist. Nat. Paris, 5:351-370.

Cuvier G. & A. Valenciennes. 1846. Histoire naturelle des Poissons. 19:1-549, n.p., Paris et Strasbourg.

_____. 1849. Histoire naturelle des Poissons. 22:1-544, n.p., Paris et Strasbourg.

Dahl, G. 1971. Los peces del norte de Colombia. INDERENA, Bogotá.

d'Orbigny, A. 1847. Voyage dans l'Amerique meridionale 1826-1833. Catalogue des principales especes de Poissons. Paris, 5(2):5-11.

Duméril, A. 1806. Zoologie analytique, ou méthode naturelle de classification des Animaux. Paris:1-344.

Duque-Caro, H. 1989. Cenozoic paleography in NW South America: Major Drainage Pattern and Implications. (Abstract and Presentation) in the Workshop on Biogeography of Neotropical Freshwater Fishes, 69th Annual Meeting of the Amer. Soc. Ichs. & Herps., San Francisco, p. 84.

Durbin, M. L. 1909. Reports on the Expedition to British Guiana of the Indiana University and the Carnegie Museum, 1908. Report No. 2. A new genus and twelve new species of tetragonopterid characins. Ann. Carnegie Mus., 6(2):55-72.

Durbin Ellis, M.L. 1911. On the species of Hasemania, Hyphessobrycon and Hemigrammus collected by J.D. Haseman for the Carnegie Museum. Ann. Carnegie Mus., 8 (2):148-164.

Eigenmann, C. 1903. New genera of South American freshwater fishes and new names for some old genera. Smithsonian Misc. Coll., 45 (1):144-148.

_____. 1907. On a collection of fishes from Buenos Ayres. Proc. Washington Acad. Sci., 8:449-456,458.

_____. 1908. Zoological Results of the Thayer Brazilian Expedition. Preliminary descriptions of new genera and species of tetragonopterid characins. Bull. Mus. Comp. Zool., 52(6):93-106.

_____. 1909a. Reports on the Expedition to British Guiana of the Indiana University and the Carnegie Museum. 1908. Report No. 1. Some new genera and species of fishes from British Guiana. Ann. Carnegie Mus., 6 (1):4-54.

_____. 1909b. Reports of the Princeton University Expedition to Patagonia 1896-1899 III. The freshwater fishes of Patagonia, and an examination of the Archiplata-Archhelenis theory. Princeton Univ. 3(1):225-374.

_____. 1910. Catalogue of the freshwater fishes of Tropical and South Temperate America. Rept. Princeton Univ. Exped. Patagonia, 3(4):376-511.

_____. 1911. Descriptions of two new tetragonopterid fishes in the British Museum. Ann. Mag. Nat. Hist., 8(7):215-217.

_____. 1912a. The Freshwater Fishes of British Guiana, including a study of the ecological grouping of species and the relation of the fauna to the plateau to that of the lowlands. Mem. Carnegie Mus., 5:1-578.

_____. 1912b. Some results from an ichthyological reconnaissance of Colombia, South America. Indiana Univ. Stud. 16:1-27.

_____. 1912c. The origin of the fish-fauna of the fresh waters of South America. Proc. 7th Intern. Zool. Cong. Boston, 958-959.

_____. 1913. Some results from an ichthyological reconnaissance of Colombia, South America. Part II. Indiana Univ. Studies, 18:1-32.

_____. 1914. On new species of fishes from the Rio Meta Basin of Eastern Colombia and on albino or blind fishes from near Bogota. Indiana Univ. Stud., 23:229-230.

_____. 1915a. The Serrasalminae and Mylinae. Ann. Carnegie Mus., 9(3-4):225-272.

_____. 1915b. The Cheirodontinae, a subfamily of minute characid fishes of South America. Mem. Carnegie Mus., 7 (1):1-99.

_____. 1916a. New and rare fishes from South American rivers. Ann. Carnegie Mus., 10(1-2):77-86.

_____. 1916b. On the species of Salminus. Ann. Carnegie Mus., 10(1-2):91-92.

_____. 1917. The American Characidae, 1. Mem. Mus. Comp. Zool., 43 (1):1-102.

_____. 1918. The American Characidae, 2. Mem. Mus. Comp. Zool., 43 (2):103-208.

_____. 1919-1920. The Cheirodontidae, a subfamily of minute characid fishes of South America. Mem. Carnegie Mus. 7(1):1-100.

_____. 1920. The Fishes of Lake Valencia, Caracas, and of the Rio Tuy at El Concejo, Venezuela. Indiana Univ. Stud., 7(44):1-13.

_____. 1921. The American Characidae, 3. Mem. Mus. Comp. Zool., 43 (3):209-310.

_____. 1922. The fishes of Western South America, part 1. The fresh-water fishes of the Northwestern South America, including Colombia, Panama, and the pacific slopes of Ecuador and Peru, together with an appendix upon the fishes of the rio Meta in Colombia. Mem. Carnegie Mus., 9 (1) 1-246.

_____. 1927. The American Characidae 4. Mem. Mus. Comp. Zool., 43 (4):311-428.

Eigenmann, C. & W. Allen. 1942. Fishes of Western South America. Univ. of Kentucky, Lexington.

Eigenmann, C. & R. Eigenmann. 1889a. A Revision of the Erythrininae. Proc. Calif. Acad. Sci., 2nd ser., 18-56.

_____. 1889b. A revision of the edentulous genera of Curimatinae. Ann. New York Acad. Sci., 4:409-440.

_____. 1891. A catalogue of the fresh-water fishes of South America. Proc. U.S. Nat. Mus., 14:1-81.

Eigenmann, C. & C. Kennedy. 1903. On a collection of fishes from Paraguay, with a synopsis of the American genera of cichlids. Proc. Acad. Nat. Sci. Philadelphia, 55(2):497-537.

Eigenmann, C. & A. Henn. 1914. On new species of fishes from Colombia, Ecuador and Brazil. Indiana Univ. Stud., 24:231-234.

Eigenmann, C., A. Henn, & C. Wilson. 1914. New fishes from western Colombia, Ecuador, and Peru. Indiana Univ. Bull 2(19):1-15.

Eigenmann, C., W. McAtee & D. Ward. 1907. VII. On further collections of fishes from Paraguay. Ann Carnegie Mus. 4(7):110-157.

Eigenmann, C. & G. Myers. 1929. The American Characidae 5. Mem. Mus. Comp. Zool., 43 (5):429-558.

Eigenmann, C. & A. Norris. 1900. Sobre alguns peixes de S. Paulo, Brazil. Rev. Mus. Paulista 4:349-362.

Eigenmann, C. & F. Ogle. 1907. An annotated list of characin fishes in the United States National Museum and the Museum of Indiana University, with description of new species. Proc. U. S. Nat. Mus. 33:1-36.

Fernández Yépez, A. 1948. Los Curimatidos (peces fluviales de Sur América) catálogo descriptivo con nuevas adiciones genéricas y específicas. Bol. Taxonómico del Lab. de Pesqería de Caiguire, edo. Sucre, Venezuela, Ministerio de Agricultura y Cría, Caracas, 1:1-86.

_____. 1949. Ramirezella newboldi nuevo género y especie de pez Tetragonopteridae colectado en Venezuela. Evencias. 6:1-3.

_____. 1949. Anostomus ternetzi nuevo anostomido de Sur America, colectado en Palital, Estado Guárico, Venezuela. Bol. Soc. Venez. Cien. Nat., 11:293-295.

_____. 1950. Notas sobre la fauna ictiológica de Venezuela. Mem. Soc. Cien. La Salle, 10(26):111-118.

_____. 1951. Serrasalmus pingke, un nuevo Serrasalmido para la fauna Neotropical. Evencias, 12:1-3.

_____. 1955. Los peces neotropicales de la familia Acestrorhynchidae. Rev. Fac. Agric., 1(4):449-459.

_____. 1965a. Un nuevo pez del genero Serrasalmus colectado en Venezuela (S. fernandezi) Evencias, 16:1-4.

_____. 1965b. Pygopristis antoni, nuevo Serrasalmido colectado en Venezuela. Evencias, 17:1-4.

_____. 1967. Venezuela y sus peces, album ictiológico, primera entrega, Bol. Estación de Investigaciones Piscícolas. MAC, 1-62.

_____. 1969. Catálogo general de la fauna ictica de Venezuela. Bol. Estac. Invest. Piscícolas, MAC.

_____. 1969. Contribución al conocimiento de los Serrasalmidos. Evencias, 23:1-5.

_____. 1972. Análisis ictiológico del complejo hidrográfico (04) "Río Yaracuy". Min. Obras Pub., Dir. Obras Hidraul. Caracas. 1-25.

Fink, S. & W. Fink. 1981. Interrelationships of the Ostariophysan fishes (Teleostei). Zool. Jour. Linnean Soc., 72(4):297-353.

Fink, W. & S. Weitzman. 1974. The so-called cheirodontin fishes of Central America with description of two new species (Pisces: Characidae). Smithsonian Contr. Zool., 172:1-46.

Fittkau, E., U. Irmler, W. Junk, F. Reiss, & G. Schmidt. 1975. Productivity, biomass, and population dynamics in Amazonian water bodies. in H. Sioli (ed.) Ecological studies 11. Tropical ecological systems. Springer Verlag, New York.

Fowler, H. 1906. Further knowledge of some heterognathus fishes. Part I. Proc. Acad. Nat. Sci. Philadelphia, 58:293-351.

_____. 1907. Further knowledge of some heterognathous fishes, part II. Proc. Acad. Nat. Sci. Philadelphia, 58:431-483.

_____. 1910. The proper restriction of Eucynopotamus. Science (N.S.), 31(803):790.

_____. 1911. Some fishes from Venezuela. Proc. Acad. Nat Sci. Philadelphia, 63:419-437.

_____. 1913a. Fowlerina Eigenmann, a preoccupied generic name. Science, 38:51.

_____. 1913b. Fishes of the Madeira River, Brazil. Proc. Acad. Nat Sci. Philadelphia 65(3):517-579.

_____. 1913c. Curimatus spilurus Cope, a wrongly identified characin. Proc. Acad. Nat. Sci. Philadelphia, 65:673-675.

_____. 1914. Fishes from the Rupununi River, British Guiana. Proc. Acad. Nat. Sci.Philadelphic, 66(2)229-284.

_____. 1931. Fishes obtained by the Barber Asphalt Company in Trinidad and Venezuela in 1930. Proc. Acad. Nat. Sci. Philadelphia, 83:391-410.

_____. 1939. A collection of fishes obtained by Mr. William C. Morrow in the Ucayali River Basin, Peru. Proc. Acad. Nat. Sci. Philadelphia, 91:219-289.

_____. 1940. Zoological results of the 2nd Bolivian Expedition for the Academy of Natural Sciences of Philadelphia 1936-1937. Part 1. The fishes. Proc. Acad. Nat. Sci. Philadelphia 92(3):43-103.

_____. 1941. Notes on Colombian fresh-water fishes with descriptions of four new species. Notula Naturae, 73:1-10.

_____. 1942. Lista de los peces de Colombia (Introduction by Cecil Miles). Rev. Acad. Colombiana Cien. Exact., Fis. Quim. Nat., 5(17):128-138.

_____. 1943a. A collection of fresh-water fishes from Colombia, obtained chiefly by Brother Niceforio Maria. Proc. Acad. Nat. Sci. Philadelphia, 95:223-266.

_____. 1943b. Notes and descriptions of new or little known fishes from Uruguay. Proc. Acad Nat. Sci. Philadelphia, 95:311-334.

_____. 1945. Los peces del Peru. Catálogo sistemático de los peces que habitan en aguas peruanas. Museo de Historia natural "Javier Prado", p. 1-298, figs. 1-92. (reprinting of earlier series).

_____. 1948-1951. Os Peixes de agua doce do Brasil Vol. 1. Arq. Zool. Est. S. Paulo.

_____. 1950. Colombian zoological survey. Part VI. Fishes obtained at Totumo, Colombia, with description of two new species. Notula Naturae, 222:1-8.

Garavello, J. 1988. A new species of the genus Leporinus Spix from the Rio Meta, Colombia, South America (Pisces, Ostariophysi, Anostomidae). Proc. Acad. Nat. Sci. Philadelphia, 40(2):143-149.

Garman, S. 1890. On the species of the genus Chalcinus in the Museum of comparative Zoology at Cambridge, Mass. USA. On species of Gasteropelecus. On species of Cynopotamus On the species of the genus Anostomus. Bull. Essex Inst., Salem, 22(1-3):1-23.

Géry, J. 1960. Contributions a l'etude de poissons characoides (No.14). Revision de la super-espece Anostomus anostomus (L.) et description de formes nouvelles: A. brevior et A. anostomus longus (Erythrinidae, Anostominae). Bulletin du Museum National d'Historire Naturelle, 2e ser, 32:498-505.

_____. 1961. Contributions a l'etude des poissons characoides 13. Structures et evolution des Anostominae. Bull. Aquatic Biol., 2:93-112.

_____. 1962. Notes on the Ichthyology of Surinam and other Guianas 10. The distribution pattern of the genus Hemibrycon, with a description of a new species from Surinam and an incursion into ecotaxonomy. Bull. Aquatic Biol., 3(28):65-80.

_____. 1963. Preliminary description of seven new species and two new genera of characoid fishes from the upper Río Meta in Colombia. Tropical Fish Hobbyist, 12(1):25-48.

_____. 1964a. Preliminary descriptions of seven new species and two new genera of characoid fishes from the upper Rio Meta in Colombia. Tropical Fish Hobbyist, 12(5):25-32, 41-48.

_____. 1964b. A review of the Chilodinae, with a key to the species. Tropical Fish Hobbyist, 12(9):5-10, 63-67, 9 figures.

_____. 1970. Le genre Iguanodectes Cope (Pisces, Characoidei). Amazoniana, 2(4):417-433.

_____. 1971. Une sous-famille nouvelle de poissons characoides sud-Americains: Les Geisleriinae. Vie et Milieu series C 12(1):153-166.

_____. 1972a. An astonishing similarity: Hemigrammus rhodostomus and Petitella georgiae. Tropical Fish Hobbyist, 20(8):30.

_____. 1972b. Poissons Characoides del Guyanes. I. Generalites. II Famille des Serrasalmidae. Zool. Verhandelingen, 122:1-250.

_____. 1972-1973. Notes sur quelques Anostomidae (Pisces: Characoidei) du bassin Amazonien. Vie et Milieu, 23:143-175.

_____. 1977. Characoids of the world. TFH Pub., Neptune City, New Jersey. 1-672.

_____. 1984. The fishes of Amazonia, in Monographie biologicae, vol. 56, (H. Sioli ed.). The Amazon. limnology and landscape ecology of a mighty tropical river and its basin. Junk Pub., Boston, 353-370.

Géry, J. & V. Mahnert. 1986. A new Rummy-nose Tetra from the Rio Negro Brazil: Hemigrammus bleheri n. sp., Tropical Fish Hobbyist, 34(11):37.

Géry, J. & Vu-Tan-Tué. 1963. Definition de Cynopotamus Val. et genres voisins (Pisces, Characoidei). Bull. Mus. Nat. Hist. 2, 35(2):143-150 & 35(3):238-246.

Gill, T. 1858. Synopsis of the Fresh Water Fishes of the Western Portion of the Island of Trinidad, W.I. Ann. Lyceum Nat. Hist. New York, 6:363-430.

_____. 1896. The differential characters of characinoid and erythrinoid fishes. Proc. U.S. Nat. Mus., 18:205-209.

_____. 1903. Note on the fish genera named Macrodon. Proc. U. S. Nat. Mus. 26:1015-1016.

Girard, Ch. 1854. Abstract of a report to Lieut. James M. Gillis U.S.N., upon the fishes collected during the U.S. Naval Astronomical Expedition to Chili. Proc. Acad. Nat. Sci. Philadelphia for 1854-55. 7:197-199.

Gistel J. 1848. Naturgeschichte des tierreichs für höhere schulen. n.p., Stuttgart.

Goeldi, E. 1898. Primeira contribuicao para o conhecimento dos peixes do valle do Amazonas e das Guyanas. Estudos ichthyologicos dos annos 1894-1898. Bull. Mus. Paraense Hist. Nat. Ethn., Para 2(4,III):443-488.

González Y., J. 1980. Reproducción y Crecimiento del "Caribe Colorado" Serrasalmus notatus Lütken, 1874 (Teleostei, Characiformes, Characidae.) en los Llanos Venezolanos. Trabajo Especial de Grado, UCV, Biología, Caracas, 1-133.

Goulding, M. 1980. The fishes and the forest. Explorations in Amazonian natural history. Univ. of Calif. Press, Berkeley & Los Angeles.

_____. 1981. Man and fisheries on an Amazon frontier. in Developments in Hydrobiology (H.Dumont, editor), W. Junk, The Hague, Netherlands.

Goulding, M., M. Leal Carvalho & E. G. Ferreira. 1988. Rio Negro, rich life in poor water. SPB Academic Pub., The Hague, Netherlands.

Gray, J. 1854. Systema Ichthyologicum, or Catalog of Fish, collected and described by L. Th. Gronow. Trustees British Mus., London.

Greenwood, P., D. Rosen, S. Weitzman & G. Myers. 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. Bull. Amer. Mus. Nat. Hist., 131(4) 339-456.

Gronow, L. (also spelled GRONOVIUS) 1754-1756. Museum Ichthyologicum. Lugduni Batavorum, 2 vols.

_____. 1763. Zoophylacii Gronoviani, fasciculus primus exhibens animalia quadrupeda, amphibia atque pisces, quae in museo suo adservat, reti examinavit, systematics disposuit, descripsit atque iconibus illustravit. L. Th. Gronovius. Lugduni Batavorum.

Günther, A. 1859. List of cold-blooded Vertebrata collected by Mr. Fraser in the Andes of western Ecuador (2nd list). Proc. Zool. Soc. London, 27:402-420.

_____. 1863. On new species of fishes from the Essequibo. Ann. Mag. Nat. Hist. London, 3(12):441-443.

_____. 1864. Catalogue of the fishes in the British Museum. Trustees of the British Museum, London.

_____. 1868a. Diagnoses of some new fresh-water fishes from Surinam and Brazil in the collections of the British Museum. Ann. Mag. Nat. Hist. London, 4(1):475-481.

_____. 1868b. Descriptions of fresh-water fishes from Surinam and Brazil. Proc. Zool. Soc. London, 229-247.

_____. 1869. Descriptions of some species of fishes from the Peruvian Amazon. Proc. Zool. Soc. London, 423-429.

_____. 1880. Contribution to the knowledge of the Fish-fauna of the Rio de la Plata. Ann. Mag. Nat. Hist., series 5, 6:7-15.

Hancock, J. 1829. Notes on some species of Fishes and Reptiles from Demerara presented to the Zoological Society by John Hancock. Zool. Jour., 4:240-247.

Hensel, K. 1962. A note on Charax gibbosus (Linné, 1758). Bull. Aquatic Biol. 3(33):127-129.

Hensel, R. 1870. Beitrage zur Kenntnis der Wirbeltiere Sudbrasiliens. Fische (2e note). archiv f. Naturgesch. 1:50-91.

Hoedeman, J. 1975. Naturalists's guide to fresh-water aquarium fish. Sterling Pub. Co., New York.

Holmberg, E. 1887. Viaje a Misiones. Boletín de la Académia Nacional de Ciéncias, Córdoba 10:1-387.

Howes, G. 1982. Review of the genus Brycon (Teleostei:Characoidei). Bull. British Mus. Nat. Hist. (Zool.), 43(1):1-47.

Humboldt, F. & A. Valenciennes. 1817. Reserches sur les poissons fluviatiles de l'Amérique équinoxiale, etc., in F.H.A. Humboldt & A.J.A. Bonpland, Voyage aux regions equinoxiales du Nouveau Contnent, fait en 1799-1804, etc., 2e partie (Zool.), Recueil d'observations de zoologie et d'anatomie comparee, 2 (4):145-216.

Ibarra, M. & D. Stewart. 1987. Catalog of type specimens of recent fishes in the Field Museum of Natural History. Fieldiana, 35(1377):1- 112.

Ihering, R. von, J. de Barros & N. Planet, 1928. Os ovulos e a desova dos peixes d'agua doce do Brasil, Bolm. biol. Brasil., S. Paulo, 14:97-109.

Inger, R. 1956. Notes on a collection of fishes from southeastern Venezuela. Fieldiana, 34(37):425-440.

Innes, W. 1966. Exotic aquarium fishes. 19th ed., Aquariums Inc., Maywood, New Jersey.

International Commission on Zoological Nomenclature. 1966. Opinion 772, Curimata Walbaum 1792 (Pisces): Rejected as a Generic Name and Placed on the Official List. Bulletin of Zoological Nomenclature, 23 (1):41- 45.

Jordan, D. & B. Evermann. 1917. The Genera of Fishes, from Linnaeus to Cuvier 1758-1833, seventy-five years, with the accepted type of each. Stanford Univ. Publ., Univ. Ser., 1-161.

_____. 1919a. The Genera of Fishes, Part II from Agassiz to Bleeker, 1833-1858, twenty-six years, with the accepted type of each. Stanford Univ. Publ., Univ. Ser., 163-284.

_____. 1919b. The Genera of Fishes, Part III from Guenther to Gill, 1859-1880, twenty-two years, with the accepted type of each. Stanford Univ. Publ., Univ. Ser., 285-410.

Jordan, D. 1920. The Genera of Fishes, Part IV from 1881 to 1920, thirty-nine years, with the accepted type of each. Stanford Univ. Publ., Univ. Ser. 413-576.

Kner, R. 1859. Zur Familie der Characinen, III. Folge der ichthyologischen Beitrage (1. Abt.). Denks. k. Akad. Wiss. Wien, 17:137-182.

_____. 1860. Zur Familie der Characinen, III. Folge der ichthyologischen Beitrage (2. Abt.) Denks. k. Akad. Wiss. Wien, 18:9- 62.

_____. 1863. Eine Ubersicht der ichthyologischen Ausbeute des Herrn Professors Dr. Mor. Wagner in Central-Amerika. Sitz. ber. Akad. Wiss., München, 2:220-230.

Knöppel, H. 1972. Zur Nahrung tropischer Süsswasserfische aus Südamerika. Amazoniana, 3:231-246.

Knöppel, H., W. Junk, & J. Géry. 1968. Bryconops (Creatochanes) inpai, a new characoid fish from the central Amazon region, with a review of the genus Bryconops. Amazoniana, 1(3):231-246.

Kushlan, J. 1976. Environmental stability and fish community diversity. Ecology, 57(4)821-825.

_____. 1980. Population fluctuations of Everglades fishes. Copeia (4):870-875.

Lacépéde, B. G. 1803. Histoire naturelle des poissons, tome 1. n.p., Paris.

Lewis, W. 1988b. Primary production in the Orinoco River. Ecology, 69(3):679-692.

Lilyestrom, C. & D. Taphorn. 1978. El coporo, Prochilodus mariae, ?Una especie en peligro? Mem. Soc. Nat. La Salle, 110(38):311-318.

_____. 1983. Aspectos sobre la biología y conservación de la Palambra Brycon whitei Myers & Weitzman. Rev. UNELLEZ Cien. Tec., 1(1):53-60.

Linnaeus, C. 1758. Systema naturae per regna tria naturae (10th edition). Museum S. R. M. Adolphi Friderici Regis Suecorum, Holmiae.

_____. 1766. Systema naturae per regna tria naturae (12th edition). Museum S. R. M. Adolphi Friderici Regis Suecorum, Stockholm.

Lowe-McConnell, R. 1963. The fishes of the Rupununi Savannah District of British Guyana, South America. J.Linn. Soc., Vol. 45.

_____. 1975. Fish communities in tropical freshwaters. Longman Press, New York.

Lütken, Ch. 1874a. Ichthyographiske Bidrag. III. Nogle nye eller mindre fuldstaendigt kjendte mellem-eller sydamerikanske karpelax (Characiner). Vidensk. Meddel, Kjobenhavn, 3 (8):220-240.

_____. 1874b. Characinae novae Brasilae centralis a clarissimo J. Reinhardt in provincia Minas Geraes circa oppidulum Lagoa Santa in lacu eiusdem nominis, flumine rio das velhas etc. Over. Danske Viden. Selsk. Forh. Kjobenhavn 3:127-143.

_____. 1875. Velhas-Flodens Fiske. Et Bidrag til Brasiliens Ichthyologi. Danske Vidensk. Selsk. Skrifter, Kjobenhavn, (5)12:122- 254.

Machado Allison, A. 1974. Etapas del desarrollo de Piabucina pleurotaenia Regan, 1903 (Characiformes, Lebiasinidae). Acta Biol. Venez., 8(3-4):579-622.

_____. 1982. Estudios sobre la Subfamilia Serrasalminae (Teleostei, Characidae). Parte I. Estudio Comparado de los Juveniles de la "Cachamas" de Venezuela (Generos Colossoma y Piaractus. Acta Biol. Venez., 11(3):1-101.

_____. 1983. Estudios sobre la sistemática de la subfamilia Serrasalminae (Teleostei, Characidae). Parte II. Discusión sobre la condición monofilética de la subfamilia. Acta Biol. Venez., 11(4):145-195.

_____. 1985. Estudios sobre la subfamilia Serrasalminae. Parte III: Sobre el estatus genérico y relaciones filogenéticas de los géneros Pygopristis, Pygocentrus, Pristobrycon, y Serrasalmus (Teleostei-Characidae-Serrasalminae). Acta Biol. Venez., 12(1):19-42.

_____. 1987. Los peces de los llanos de venezuela. Un ensayo sobre su historia natural. Universidad Central de Venezuela, Caracas.

Machado Allison, A. & C. García. 1986. Food habits and morphological changes during ontogeny in three serrasalmin fish species of the Venezuelan floodplains. Copeia, 1986(1):193-195.

Mago Léccia, F. 1967. Notas preliminares sobre los peces de los llanos de Venezuela. Bol. Soc. Venez. Cien. Nat., 27(112):237-263.

_____. 1970a. Estudios preliminares sobre la ecología de los peces de los llanos de Venezuela. Acta Biol. Venez., 7(1):71-102.

_____. 1970b. Lista de los peces de Venezuela. MAC, Oficina de Pesca, Caracas.

_____. 1972. Consideraciones sobre la sistemática de la familia Prochilodontidae (Osteichthys, Cypriniformes), con una sinopsis de las especies de Venezuela. Acta Biológica Venezuélica. 8(1):35-96.

_____. 1978. Los peces de agua dulce de Venezuela. Lagoven, Caracas.

Margrave, G. 1648. Historiae rerum naturalium brasiliae, libri octo: quorum...quartus de Piscibus. Lugduni Batavorum et Amsterodami.

Meek, S. 1907. Synopsis of the Fishes of the Great Lakes of Nicaragua. Publ. Field Mus. (Zool. Ser. 121) 7(4):97-132.

Meinken, H. 1935. Beitrage zur Fischfauna des mittleren Parana. I. blatt. Aquar. Terr., 46(9):193-196.

Menézes, N. 1969a. The food of Brycon and three closely allied genera of the tribe Acestrorhynchini. Pap. Avuls. Zool. S. Paulo, 22:217-233.

_____. 1969b. Systematics and evolution of the tribe Acestrorhynchini (Pisces, Characidae) Arq. de Zool. S. Paulo, 18 (1-2):1-150.

_____. 1976. On the Cynopotaminae, a new subfamily of Characidae (Osteichthyes, Ostariophysi, Characoidei). Arq. Zool. S. Paulo, 28(2):1-91.

_____. 1977. Acestrocephalus boehlkei, a new and disjunct Cynopotamine from Ecuadorean and Peruvian Amazon (Osteichthyes, Ostariophysi, Characidae). Pap. Avuls. Zool., S. Paulo, 30(13):185- 193.

Menézes, N. & J. Géry. 1983. Seven new Acestrorhynchin Characid species (Osteichthyes, Ostariophysi, Characiformes) with comments on the systematics of the group. Revue Suisse Zool., 90(3):563-592.

Müller, J. 1842. Beobachtungen über die Schwimmblase der Fische, mit Bezug auf einige neue Fisch-Gattungen. I. Über zellige Schwimmblasen und Lungen. II. Über eine Familie der Weichflosser mit Gehörknöchelchen der Schwimmblase, mit Bemerkungen über die Systematik der Weichflosser. Arch. Anat. Phys. Wiss. Med., 307-329

Müller, J. & F. Troschel. 1844. Synopsis generum et specierum familiae Characinorum (Prodromus descriptionis novorum generum et specierum). Archiv. Naturgesch., 10(1):81-99.

_____. 1845. Horae Ichthyologicae. Beschreibung und Abbildung neuer Fische; erstes un zweites Heft. Die Familie der Characinen. Berlin:1-40.

_____. 1848. Reisen in Britisch-Guiana in de Jahren 1840-44 (Im Auftrag Sr. Majestät des Königs von Preussen ausgeführt von Richard Schomburgk: Versuch einer Fauna u. Flora von Britisch-Guiana. Fische), 3. Berlin:618-644.

Myers, G. 1927. Descriptions of New South American Fresh-water Fishes Collected by Dr. Carl Ternetz. Bull. Mus. Comp Zool., 68(3):107-135.

_____. 1930. Fishes from the upper rio Meta Basin, Colombia. Proc. Biol. Soc. Wash., 43:65-72.

_____. 1934. Gnathocharax steindachneri, a new characin for the aquarium. The Home Aquarium Bull., 4(7):5 & 29-30.

_____. 1942. Studies on South American Fresh-water Fishes. I. Stanford Ich. Bull., 2(4):89-114.

_____. 1950. Studies on South American freshwater fishes. II. The genera of anostomine characids. Stanford Ich. Bull., 3:184-198.

_____. 1956. Copella a new genus of Pyrrhulinin Characid fishes from the Amazon. Stanford Ich. Bull., 7:12-13.

_____. 1972. (editor) The piranha book. TFH Publications, Neptune City, New Jersey, 1-128.

Myers, G. & T. Roberts. 1967. Note on the dentition of Creagrudite maxillaris, a characid fish from the upper Orinoco--upper Rio Negro System. Stanford Ich. Bull., 8(4):248-9.

Myers, G. & S. Weitzman. 1960. Two new fishes collected by General Thomas D. White in Eastern Colombia. Stanford Ich. Bull., 7(4):98-108.

Nakashima, A. 1941. Algunos peces del Oriente peruano. Bol. Mus. Hist. Nat. "Javier Prado", 5(16):77.

Nelson, J. 1976. Fishes of the world. Wiley & Sons, New York, NY.

_____. 1984. Fishes of the world. Wiley & Sons, New York, NY., second edition.

Nico, L. & D. Taphorn. 1985. Diet of Acestrorhynchus microlepis (Pisces:Characidae) in the low llanos of Venezuela. Copeia, (3):794-796.

_____. 1986. Those Bitin' Fish from South America. Tropical Fish Hobbyist, 34(4): 24-27, 30-34, 36, 40-41,56-57.

_____. 1988. Food Habits of Piranhas in the Low Llanos of Venezuela. Biotropica, 20(4):311-321.

Norman, J. 1926. Descriptions of nine new freshwater fishes from French Guiana and Brazil. Ann. Mag. Nat. Hist., 18(9):91-97.

_____. 1928. The South American characid fishes of the subfamily Serrasalmoninae, with a revision of the genus Serrasalmus Lacepede. Proc. Zool Soc. London, 52:781-830.

Novoa, R., D. (editor) 1982. Los recursos pesqueros del Rio Orinoco y su explotacion. Corp. Venez. Guayana, Editorial Arte, Caracas.

Pearse, A. 1920. The fishes of Lake Valencia, Venezuela. Univ. Wisconsin Stud. Sci., 1:1-51.

Pearson, N. 1925. The fishes of the eastern slope of the Andes. I. The fishes of the rio Béni basin, Bolivia, collected by the Mulford Expedition. Indiana Univ. Stud., 11:(64)1-58.

Pellegrin, J. 1899. Note sur les Poissons recueilles par M. F. Geay dans l'Apure et ses affluents. Bull. Mus. Hist. Nat., Paris, 156-159.

_____. 1907. Characinidés américains nouveaux de la collection du muséum d'Histoire Naturelle. Bull. Mus. Hist. Nat. Paris, 13:25-27.

_____. 1908. Characinidés américains nouveaux de la collection du Muséum d'Histoire Naturelle. Bull. Mus. Hist. Nat. Paris, 14:342-347.

_____. 1909. Characinides americains nouveaus de la collection du Muséum d'Histoire Naturelle. Bull. Mus. Hist. Nat. Paris, 15:12-14.

Perugia, A. 1891. Appunti sopra alcuni pesci sud-americani conservati new Museo civico de Storia naturele di Genova. Ann. Mus. Civ. Storia Nat. Genova, 2(10):605-657.

_____. 1897. Di alcuni pesci raccolti in Bolivia dal Prof. Luigi Balzan. Ann. Mus. Civ. Storia Nat. Genova, 18:16-27.

Peters, M. 1877. Ueber die von Herrn Dr. C. Sachs in Venezuela gesammelten Fische. Monatsb. Ak. Wiss. Berlin. 26, 1877:469-473.

Quoy, J. & P. Gaimard. 1824. Voyage autour du monde ...exécuté sur les corvettes de S. M. l'Uranie et la Physicienne pendant les années, Zoologie. Poissons, 9:192-401.

Rafinesque, C. 1815. Analyse de la nature, ou tableau de l'univers et des corps organises. Palerme.

Ramia, M. & G. Morales. 1978. El estero llanero. Natura, 63:36-41.

Rantin, F. & K. Johansen. 1984. Responses of the teleost Hoplias malabaricus to hypoxia. Env. Biol. Fishes, 2(3):221-228.

Ramírez E., M. 1957. Nuevas especies para la fauna ictiológica Venezolana. Boletin de la Sociedad Venezolana de Ciencias Naturales, 18:157-162.

_____. 1960. Nuevos peces para la fauna venezolana. Mem. Soc. Cienc. Nat. La Salle, 20(56):126-131.

_____. 1965a. Serrasalmus altuvei, un nuevo Serrasalmido para la fauna neotropical. Evencias, Venezuela 14:1-4.

_____. 1965b. Serrasalmus medinai, un nuevo Serrasalmido procedente de Venezuela, Evencias, 14:1-4.

Regan, C. 1903. Descriptions of new South American fishes in the collections of the British Museum. Ann. Mag. Nat. Hist., 7(12):621- 630.

_____. 1906. On the Freshwater fishes of the Island of Trinidad, based on the collection, notes, and sketches made by Mr. Lechmere Guppy, Jr. Proc. Zool. Soc. London (1):378-393.

Reinhardt, J. 1849. Nye sydamerikanske Ferskvandsfiske. Vidensk. Meddel. Naturh. Foren. Kjobenhavn, (3-5):29-57.

_____. 1866. Om trende, forementligt Fiske af Characinernes eller Karpelaxenes Familie. Oversigt Danske Vidensk. Selsk. Forhandl. Kjobenhavn, 49-68.

Ribeiro, A. de Miranda. 1907. Peixes do Iporanga--S. Paulo; resultados de excursoes de o Sr. Ricardo Krone, membro correspondente de Museu nacional do Rio de Janeiro. Bol. Soc. Nac. Agric. A Lavoura, Rio de Janeiro, 11(5):185-190.

Richter, H. 1986. The Swordtail Characin, Corynopoma riisei. Tropical Fish Hobbyist, 35 (1):44.

Ringuelet, T. , R. Aramburu, & A. de Aramburu. 1967. Los peces argentinos de agua dulce. Buenos Aires Gobernación, Comisión de Investigación Científica, La Plata.

Röhl, E. 1942. Fauna descriptiva de Venezuela, n.p., Caracas.

Roberts, T. 1969. Osteology and relationships of characoid fishes, particularly the genera Hepsetus, Salminus, Hoplias, Ctenolucius and Acestrorhynchus. Proc. Cal. Acad. Sci., 4th Ser., 36:391-500.

_____. 1973. Osteology and relationships of the Prochilodontidae, a South American family of Characoid fishes. Bull. Mus. Comp. Zool., 145(4):213-235.

_____. 1974. Osteology and classification of the neotropical characoid fishes of the families Hemiodontidae (including Anodontinae) and Parodontidae. Bull. Mus. Comp. Zool., 146(9):411-472.

Román, M. 1981. Los peces de los llanos de venezuela. Los pavones. Fundación Científica Fluvial de los Llanos, Caracas.

_____. 1982. Los peces de los llanos de venezuela. Los bagres. Fundación Científica Fluvial de los Llanos, Caracas.

_____. 1983. Los peces de los llanos de venezuela. Las pirañas. Fundación Científica Fluvial de los Llanos, Caracas.

_____. 1985. Peces de agua dulce de Venezuela I. Editorial Biosfera. Caracas.

Saavedra M., N. 1984. Contribución al estudio de la biología de la "Guabina" Hoplias malabaricus (Bloch, 1794), en el módulo "Fernando Corrales" (UNELLEZ), estado Apure. Trabajo de Aplicación de Conocimiento, Programa RNR, UNELLEZ, Guanare, Venezuela.

Sachs, C. 1879. Aus dem Llanos. Schilderung einer Naturwissenschaftlichen Reise nach Venezuela, n.p., Leipzig.

Saunders, J. & W. Lewis. 1987. Zooplankton abundance in the Caura River, Venezuela. Biotropica, 20(3):206-214.

_____. 1988a. Transport of phosphorus, nitrogen, and carbon by the Apure River, Venezuela. Biogeochemistry 5:323-342.

_____. 1988b. Zooplankton abundance and transport in a tropical white-water river. Hydrobiologia, 162:147-155.

Schindler, O. 1939. Uber die Fischausbeute der 3 Südamerika Expeditionen Prof. Kriegs. Sitz. ber Gesell. Naturf. Fr., Berlin (1938):268-302.

Schomburgk, R. 1841. The natural history of the fishes of Guiana, part 1. The Naturalist's Library, Edinburgh, conducted by Sir William Jardine. Ichthyology, 3:1-263.

_____. 1843. The natural history of the fishes of Guiana, part 2. The Naturalist's Library, Edinburgh, conducted by Sir William Jardine. Ichthyology, 5:129-214.

_____. 1848. in Müller & Troschel, 1848. Reisen in Britisch-Guiana in de Jahren 1840-44 (Im Auftrag Sr. Majestät des Königs von Preussen ausgeführt von Richard Schomburgk: Versuch einer Fauna u. Flora von Britisch-Guiana. Fische), 3. Berlin:618-644.

Schultz, L. 1944a. The catfishes of Venezuela, with descriptions of thirty-eight new forms. Proc. U. S. Nat. Mus., 94:173-338.

_____. 1944b. The Fishes of the Family Characinidae from Venezuela, with Descriptions of Seventeen New Forms. Proc. U.S. Nat. Mus. 95:235-367.

_____. 1950. Review of thirteen genera of South American fishes in the subfamilies Cynodontinae, Hepsetinae & Characinae, with the description of a new Cyrtocharax. Studies honoring T. Kincaid, Univ. Washington, Seattle:44-73.

Scopoli, G. 1777. Introductio ad historiam naturalem, n.p., Prague.

Sioli, H. 1984. The Amazon and its main affluents: hydrography, morphology of the river courses, and river types. in H. Sioli (ed.), The Amazon. Junk Pub., Dordrecht.

Smith, N. 1981. Man, fishes and the Amazon. Columbia Univ. Press, New York.

Spix, J. von, 1829 in Agassiz, L., 1829. Selecta genera et species Piscium quos in itinere per Brasiliam (1817-1820), collegit et pigendos J.B. Spix, Munich.

Steindachner, F. 1874. Die Susswasserfische des sudostlichen Brasilien. II Abtrheilung, Fam. Characinidae. Sitz. Akad. Wiss. Wien, 69:524-538.

_____. 1875. Die Susswasserfische des südöstlichen Brasilien (II). Sitz. Akad. Wiss. Wien,, 71:211-245.

_____. 1876. Ichthyologische Beitrage (V). II Uber einige neue Fischarten, insbesondere Characinen und Siluroiden aus dem Amazonenstrome. Sitz. Akad. Wiss. Wien, 74:73-135.

_____. 1878. Zur Fisch-Fauna des Magdalenen Stromes. Denks. K. Akad. Wiss. Wien, 39:47-69.

_____. 1879a. Uber einige neue und seltene Fisch-Arten aus den K.K. Zool. Museum zu Wien, Stuttgart und Warschau. IV. Uber einige neu und seltene Fisch-Arten aus dem La Plata. VI. Sitz. Akad. Wiss. Wien, 41:2-25 & 49-52.

_____. 1879b. Beiträge zur Kenntnis der Flussfische Südamerikas (I) Denks. Akad. Wiss. Wien, 41:152-157 & 166-172.

_____. 1879c. Ichthyologische Beiträge, 8. Vorläufige Mittheilung über einige neue Siluroiden und Characinen aus dem Cauca. Sitz. Akad. Wiss. Wien, 80:68-75.

_____. 1881. Beiträge zur Kenntiss der Flussfische Sudamerika's. II. Beschreibungen von 51 Fisch-Arten. Denks. Akad. Wiss. Wien., 43:103-146.

_____. 1882. Bietrage zur Kenntnis der Flussfische SudAmerikas (III). Denks. Akad. Wiss. Wien, 44:11-13.

_____. 1908a. Uber eine neue Metynnis-Art (Fam. Characidae) aus einer Lagune am Rio Medonho. Anz. Akad. Wiss. Wien, 45 (17):326-327.

_____. 1908b. Uber sechs neue Serrasalmo- un Myletes-Arten aus SudAmerika. Anz. Akad. Wiss. Wien, 45(17):359-367.

_____. 1910a. Die Fische des Itapoci un seiner Zuflusse in Staate Santa Catarina (Br.) Ann. des K. K. Nat. Hofmuseums, Wien, 24:421-433.

_____. 1910b. Notiz über einige neue Characinenarten aus dem Orinoco und dem Oberen Surinam. Anz. Akad. Wiss. Wien, 47:265-270.

_____. 1915. Beiträge zur Kenntnis der Flussfische Sudamerikas. Denks. Akad. Wiss. Wien, 93:15-106.

Sterba, G. 1972. Dr. Sterba's aquarium handbook. Pet Library Ltd. London, England.

Swainson, W. 1839. On the natural history and classification of fishes, amphibians, and reptiles. The Cabinet Cyclopaedia, conducted by the Rev. Dionysius Lardner, London.

Taphorn, D. & C. Lilyestrom. 1980. Piabucina pleurotaenia Regan, a synonym of P. erythrinoides Valenciennes (Pisces: Lebiasinidae); its distribution, diet and habitat in Lake Maracaibo Basin, Venezuela. Copeia, 1980(2):335-340.

_____. 1984. Los Peces del Módulo "Fernando Corrales". Resultados Ictiológicos del Proyecto de Investigación del CONICIT - PIMA 18. Rev. UNELLEZ Cien. Tec., 2(2):55-86.

_____. 1988. Adaptaciones climatológicas de los peces de los llanos Venezolanos en el desague del Río Apure. in Wildlife in the Everglades and latin american wetlands, G. Dalrymple, W. Loftus and F. Bernardino, (eds.), 49-50.

Tortonese, E. 1941-42. Ricerche ed osservazioni sui Characidi delle Sottofamiglie Tetragonopterinae, Glandulocaudinae e Stethaprioninae (Teleostei: Plecospondyli), Boll. Mus. Zool. Anat. Camp. Torino (3), 47(89):43-56.

Traupman, J. 1966. The new college Latin and English dictionary, Bantam Books, New York, NY.

Travassos, H. 1946. Contribuicoes para o conhecimento da familia Characidae Gill 1893. III Discussao sobre os generos "Cynodon" Spix, 1829, e "Rhaphiodon" Agassiz, 1829, com novo nome de subfamilia (Classe Actionopterigii -- Ordem Ortareophygii (sic)). Summa brasil. Biol., I(9):129-141.

Travassos, H. 1959. A new species of characid fish from Trinidad, Aphyocharax axelrodi. Tropical Fish Hobbyist, 7(6):5-7 & 48-49.

_____. 1967. Tres novas espécies do genero Characidium Reinhardt, 1866 (Actinopterigii, Characoidei). Pap. Avuls. Dep. Zool., S. Paulo, 20(4):45-53.

Ulrey, A. 1894. Preliminary Descriptions of some new South American Characinidae. American Naturalist, 28:610-612.

_____. 1895. The South American Characinidae collected by Charles Frederick Hartt. Ann. New York Acad. Sci., 8:258-300.

Valenciennes. A. 1840. in Cuvier, G. & A. Valenciennes, Histoire naturelle de poissons. C. Pitois, Paris.

_____. in d'Orbigny. 1847. Voyage Amer. Merid., Poiss., 5(2):8.

Vanzolini, P. & R. Reboucas. 1965. Notas sobre o crescimento de Astyanax bimaculatus (Pisces, Charcidae). Pap. Avuls. Dept. Zool., S. Paulo, 17:181-190.

Vari, R. 1977. Notes on the characoid subfamily Iguanodectinae, with a description of a new species. Amer. Mus. Nov. 2612:1-6.

_____. 1983a. Two new fish species of the genus Curimata (Pisces: Curimatidae) from Venezuela. Acta Biologica Venezuelica, 11(4):27-44.

_____. 1983b. Phylogenetic relationships of the Families Curimatidae, Prochilodontidae, Anostomidae, and Chilodontidae (Pisces: Characiformes). Smithsonian Cont. Zool., (378):1-60.

_____. 1984. Systematics of the neotropical characiform genus Potamorhina (Pisces: Characiformes). Smithsonian Cont. Zool. 400:36 pages, 17 figures.

_____. 1986. Serrabrycon magoi, a new genus and species of scale-eating characid (Pisces:Characiformes) from the upper Río Negro. Proc. Biol. Soc. Wash., 99(2):328-334.

_____. 1989. A phylogenetic study of the neotropical characiform family Curimatidae (Pisces: Ostariophysi). Smithsonian Contr. Zool. 471:1-71.

Vari, R. & A. Williams. 1987. Headstanders of the Neotropical Anostomid Genus Abramites (Pisces: Characiformes: Anostomidae). Proc. Biol. Soc. Wash., 100(1):80-103.

Viera, I. & J. Géry. 1979. Crescimento diferencial e nutricao em Catoprion mento (Characoidei). Peixe lepidófago da Amazonia. Acta Amazonica, 9(1): 143-146.

Walbaum, J. 1792. Petri Artedi sueci genera piscium. Ichthyologia pars III. Emendata et aucta. Grypeswaldiae.

Weitzman, S. 1954. The osteology and the relationships of the South American characid fishes of the subfamily Gasteropelecinae. Stanford Ich. Bull., 4(4):213-263.

_____. 1960a. Pyrrhulina spilota, A New Species of characid fish from South America. Stanford Ich. Bull., 7(4):109-113.

_____. 1960b. Further notes on the relationships and classification of the South American characid fishes of the subfamily Gasteropelecinae. Stanford Ich. Bull., 7(4):217-239.

_____. 1960b. The phylogenetic relationships of Triportheus, a genus of South American fishes. Stanford Ich. Bull., 7(4):239-244.

_____. 1962. The osteology of Brycon meeki. a generalized characid fish, with an osteological definition of the family. Stanford Ich. Bull., 8(1)1-77.

_____. 1964. Osteology and relationships of South American characid fishes of subfamilies Lebiasininae and Erythrininae with special reference to the subtribe Nannostomina. Proc. U. S. Nat. Mus., 116:127-170.

_____. 1986. A new species of Elachocharax (Teleostei: Characidae) from the Río Negro region of Venezuela and Brazil. Proc. Biol. Soc. Washington, 99(4):739-747.

Weitzman, S. & J. Cobb. 1975. A revision of the South American fishes of the genus Nannostomus Günther (Family Lebiasinidae). Smithsonian Cont. Zool., 186:1-36.

Weitzman, S. & J. Géry. 1981. The relationships of the South American pygmy characoid fishes of the genus Elachocharax, with a redescription of Elachocharax junki (Teleostei: Characidae). Proc. Biol. Soc. Washington, 93(4):887-913.

Weitzman, S. & R. Kanazawa. 1976. Ammocryptocharax elegans, a new genus and species of riffle-inhabiting characoid fish (Teleostei: Characidae) from South America. Proc. Biol. Soc. Washington, 89(26):325-346.

_____. 1977. A new species of pygmy characoid fish from the Río Negro and Río Amazonas, South america (Teleostei: Characidae). Proc. Biol. Soc. Washington, 90(1):149-160.

_____. 1978. The South American fish genus Elachocharax Myers with a description of a new species (Teleostei: Characidae). Proc. Biol. Soc. Washington, 91(1):158-183.

Winemiller, K. & D. Taphorn. 1989. La evolución de las estrategias de vida en los peces de los llanos occidentales de Venezuela. Biollania 6.

Winterbottom, R. 1980. Systematics, osteology and phylogenetic relationships of fishes of the ostariophysan subfamily Anostominae (Characoidei, Anostomidae). Life Sciences Contribution: 123. Royal Ontario Museum.

Zinck, A. 1977. RIOS DE VENEZUELA. Cuadernos Lagoven. Caracas.

APPENDIX
NUMBER OF SPECIMENS EXAMINED

	Lots	Specimens
Anostomidae		
Abramites hypselonotus	14	28
Anostomus ternetzi	19	69
Leporellus vittatus	16	49
Leporinus cf granti	4	6
Leporinus friderici	64	230
Leporinus sp.	25	81
Leporinus sp. "aguaro"	3	3
Leporinus striatus	35	109
Leporinus yophorus	11	84
Pseudanos gracilis	5	8
Pseudanos irinae	6	17
Schizodon isognathus	92	296
SUBTOTALS:	294	980
Characidae		
Acestrocephalus cf boehlkei	13	80
Acestrorhynchus falcirostris	1	1
Acestrorhynchus sp "pico largo"	2	37
Acestrorhynchus microlepis	46	334
Aphyocharax alburnus	323	6992
Astyanax bimaculatus	319	6704
Astyanax integer	106	691
Astyanax metae	70	1002
Astyanax polylepis	41	642
Astyanax superbus	23	278
Astyanax venezuelae	10	105
Brycon bicolor	3	3
Brycon whitei	24	42
Bryconamericus sp.	77	3096
Bryconamericus beta	140	2838
Bryconamericus deuterodonoides	117	5187
Bryconops affinis	1	11
Bryconops melanurus	19	256
Catoprion mento	24	187
Charax gibbosus	144	985
Cheirodon pulcher	431	21330
Cheirodontops geayi	101	1705
Colossoma macropomum	0	0
Corynopoma riisei	28	362
Creagrutus cf beni	87	1315

APPENDIX. (continued).

	Lots	Specimens
Creagrutus bolivari	71	759
Creagrutus n. sp.	33	575
Ctenobrycon spilurus	355	16691
Cynopotamus bipunctatus	31	220
Engraulisoma cf taeniatum	31	129
Galeocharax sp.	22	306
Gephyrocharax valenciae	211	5636
Gnathocharax steindachneri	2	2
Gymnocorymbus thayeri	157	11035
Hemibrycon metae	87	1190
Hemigrammus analis	11	147
Hemigrammus barrigonae	57	1373
Hemigrammus cf elegans	6	50
Hemigrammus marginatus	4	125
Hemigrammus micropterus	184	3767
Hemigrammus microstomus	37	2096
Hemigrammus cf mimus	16	594
Hemigrammus newboldi	23	252
Hemigrammus cf rhodostomus	4	116
Hemigrammus cf schmardae	16	607
Hemigrammus sp. "arriba"	149	4733
Hemigrammus stictus	1	1
Heterocharax macrolepis	2	5
Hyphessobrycon bentosi	21	112
Hyphessobrycon metae	28	348
Iguanodectes spilurus	20	348
Markiana geayi	124	878
Megalamphodus cf axelrodi	17	83
Metynnis argenteus	24	178
Metynnis hypsauchen	3	8
Metynnis luna	15	89
Microschemobrycon casiquiare	6	41
Moenkhausia chrysargyrea	6	38
Moenkhausia copei	42	1378
Moenkhausia dichroura	118	2210
Moenkhausia lepidura complex	44	722
Myleus cf pacu	1	1
Myleus rubripinnis	10	13
Mylossoma aureum	0	0
Mylossoma duriventris	49	203
Paragoniates alburnus	61	222
Parapristella georgiae	8	462
Phenacogaster megalostictus	17	183
Piaractus brachypomus	15	31
Poptella orbicularis	108	3662
Pristobrycon striolatus	12	40
Pygocentrus caribe	174	1136
Pygopristis denticulatus	1	4
Roeboides affinis	111	826
Roeboides dayi	279	8067
Salminus hilarii	15	26
Serrabrycon magoi	2	7

APPENDIX. (continued).

	Lots	Specimens
Serrasalmus altuvei	6	14
Serrasalmus medinai	68	216
Serrasalmus elongatus	17	51
Serrasalmus irritans	142	744
Serrasalmus rhombeus	61	136
Tetragonopterus argenteus	35	178
Triportheus albus	5	181
Triportheus angulatus	39	105
Triportheus sp. "cola roja"	107	1045
Xenagoniates bondi	87	574
Unidentified	1	219
SUBTOTALS:	5559	129371
Characidiidae		
Ammocryptocharax elegans	1	1
Characidium cf zebra	26	191
Characidium sp. D	8	17
Characidium chupa	7	9
Characidium sp. K	4	36
Characidium sp. J	6	24
Characidium cf catenatum	82	389
Characidium sp. G	83	464
Characidium voladorita	46	302
Elachocharax junki	1	7
Elachocharax pulcher	2	8
SUBTOTALS:	266	1448
Chilodontidae		
Chilodus punctatus	24	156
Ctenoluciidae		
Boulengerella lucia	10	11
Curimatidae		
Steindachnerina sp.	27	182
Steindachnerina argentea	314	4229
Curimata cerasina	69	253
Cyphocharax spilurus	78	2495
Curimatella bolivarensis	7	32
Curimatella immaculata	103	2809
Potamorhina altamazonica	12	20
Psectrogaster ciliatus	4	16
SUBTOTALS:	614	10036

APPENDIX. (continued).

	Lots	Specimens
Cynodontidae		
Hydrolycus scomberoides	14	80
Rhaphiodon gibbus	8	22
Rhaphiodon vulpinus	12	66
SUBTOTALS:	34	168
Erythrinidae		
Hoplerythrinus unitaeniatus	38	120
Hoplias macrophthalmus	2	2
Hoplias malabaricus	252	649
SUBTOTALS:	292	771
Gasteropelecidae		
Thoracocharax stellatus	161	2777
Hemiodontidae		
Hemiodopsis argenteus	2	2
Hemiodopsis gracilis	2	31
SUBTOTALS:	4	33
Lebiasinidae		
Copella metae	9	64
Lebiasina erythrinoides	32	407
Pyrrhulina cf lugubris	157	2198
SUBTOTALS:	198	2669
Parodontidae		
Parodon sp. "linea"	24	344
Parodon apolinari	44	229
SUBTOTALS:	68	573
Prochilodontidae		
Prochilodus mariae	114	348
Semaprochilodus kneri	4	6
SUBTOTALS:	118	354
TOTAL	7642	149347

BIOGRAPHICAL SKETCH

Mr. Donald Charles Taphorn was born in Belleville, Illinois, on the eighth of September in 1951 to Mrs. Shirley Jean Taphorn nee Baechle and Mr. Donald Clemens Taphorn, as the first of five children. His interest in fishes began with the gift of a goldfish from his grandmother, and as an aquarist the hobby soon mushroomed from one goldfish bowl to a basement full of tropical fish aquaria.

After attending Catholic grade school and high school in Belleville, he enrolled as a biology major at Southern Illinois University at Edwardsville. There he met ichthyologist Dr. Jamie E. Thomerson, who hired him to work in the aquarium room, and later introduced him to the tropics and annual killyfish. In 1972, he graduated from SIUE, and was awarded an Outstanding Biology Senior Award. That same year, he moved to Gainesville, Florida, to enroll in the graduate program of the Department of Zoology at the University of Florida. His major professor was Dr. Carter Gilbert, curator of fishes at the Florida State Museum. After finishing the necessary course work, he began work on a revision of the cyprinodontid genera Austrofundulus and Rachovia, the topic of his masters degree, which was completed in 1976.

In 1976 he accepted an offer of employment from DISCA (Department of Environmental Contamination Research) of the Venezuelan Ministry of the Environment. From 1976-1977 he worked with Mr. Craig Lilyestrom on an inventory and food-habit study of the fishes of the Lake Maracaibo

Basin, in search of fishes that might be useful in the biological control of mosquito larvae.

From 1977-1978, he worked at the University of Zulia in Maracaibo, teaching fish systematics in the Department of Hydrobiology. Since January, 1979 he has been a member of the faculty of the Universidad Nacional Experimental de los Llanos Occidentales Ezequiel Zamora (UNELLEZ), a federal university in Guanare, state of Portuguesa, as a Professor of Vertebrate Zoology and Aquatic Resource Management in the Environmental Engineering Department, and as Curator of Fishes and Director of the Museum of Zoology. In 1989 he was appointed as coordinator of the Graduate Program in Wildlife and Fisheries Management being developed jointly by UNELLEZ and the International Office of the U. S. Fish and Wildlife Division.

His research is dedicated to the taxonomy and biology of freshwater Venezuelan fishes. Current research topics include an inventory of the other (non-characiform) fishes present in the Apure River drainage, and a review of the fishes of the family Rivulidae in Venezuela being carried out jointly with Dr. J. E. Thomerson. He has published over thirty-five scientific papers on neotropical freshwater fishes.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Carter R. Gilbert, Chairman
Professor of Zoology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Horst Schwassmann
Professor of Zoology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Frank Nordlie
Professor of Zoology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Richard Kiltie
Associate Professor of Zoology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Nigel Smith
Professor of Geography

This dissertation was submitted to the Graduate Faculty of the Department of Zoology in the College of Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

May, 1990

Dean, Graduate School

UNIVERSITY OF FLORIDA
3 1262 07332 005 2